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Navy Aegis Ballistic Missile Defense (BMD) Program: Background and Issues for Congress

Updated September 15, 2021

Congressional Research Service
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RL33745

CRS REPORT
Prepared for Members and
Committees of Congress

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SUMMARY

RL33745

September 15, 2021

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Navy Aegis Ballistic Missile Defense (BMD) Program: Background and Issues for Congress

The Aegis ballistic missile defense (BMD) program, which is carried out by the Missile Defense Agency (MDA) and the Navy, gives Navy Aegis cruisers and destroyers a capability for conducting BMD operations. BMD-capable Aegis ships operate in European waters to defend Europe from potential ballistic missile attacks from countries such as Iran, and in in the Western Pacific and the Persian Gulf to provide regional defense against potential ballistic missile attacks from countries such as North Korea and Iran. MDA's FY2022 budget submission states that "by the end of FY 2022 there will be 48 total BMDS [BMD system] capable ships requiring maintenance support."

The Aegis BMD program is funded mostly through MDA's budget. The Navy's budget provides additional funding for BMD-related efforts. MDA's proposed FY2021 budget requested a total of $1,647.9 million (i.e., about $1.6 billion) in procurement and research and development funding for Aegis BMD efforts, including funding for two Aegis Ashore sites in Poland and Romania. MDA's budget also includes operations and maintenance (O&M) and military construction (MilCon) funding for the Aegis BMD program.

Issues for Congress regarding the Aegis BMD program include the following:

- whether to approve, reject, or modify MDA's annual procurement and research and development funding requests for the program;
- the impact of the COVID-19 pandemic on the execution of Aegis BMD program efforts;
- what role, if any, the Aegis BMD program should play in defending the U.S. homeland against attack from ICBMs;
- required numbers of BMD-capable Aegis ships versus available numbers of BMD-capable Aegis ships;
- the burden that BMD operations may be placing on the Navy's fleet of Aegis ships, and whether there are alternative ways to perform BMD missions now performed by U.S. Navy Aegis ships, such as establishing more Aegis Ashore sites;
- allied burden sharing—how allied contributions to regional BMD capabilities and operations compare to U.S. naval contributions to overseas regional BMD capabilities and operations;
- whether to procure and install an Aegis Ashore system on Guam;
- whether to convert the Aegis test facility in Hawaii into an operational land-based Aegis BMD site;
- the potential for ship-based lasers to contribute in coming years to Navy terminal-phase BMD operations and the impact this might eventually have on required numbers of ship-based BMD interceptor missiles; and
- technical risk and test and evaluation issues in the Aegis BMD program.

Contents

Introduction 1
Background 1
Aegis Ships 1
Ticonderoga (CG-47) Class Aegis Cruisers 1
Arleigh Burke (DDG-51) Class Aegis Destroyers 1
Aegis Ships in Allied Navies 2
Aegis BMD System 2
Versions and Capabilities of Aegis BMD System 2
Aegis BMD Interceptor Missiles 4
Numbers of BMD-Capable Aegis Ships 5
BMD-Capable Aegis Destroyers Forward-Homeported in Spain 5
Aegis Ashore Sites 6
Two Navy-Operated Sites in Romania and Poland 6
Navy Interest in Divesting Aegis Ashore Sites It Operates 7
Japan Planned and Later Canceled Two Sites 8
Aegis BMD Development Philosophy and Flight Tests 9
Allied Participation and Interest in Aegis BMD Program 10
Japan 10
South Korea 11
Other Countries 11
FY2022 MDA Procurement and R&D Funding 11
Issues for Congress 12
Annual Funding Request 12
COVID-19 Impact 12
Potential for Intercepting ICBMs 12
Required vs. Available Numbers of BMD-Capable Aegis Ships 15
Burden of BMD Mission on U.S. Navy Aegis Ships 16
Allied Burden Sharing: U.S. vs. Allied Contributions to Regional BMD Capabilities 19
Potential Aegis Ashore Site on Guam 20
Conversion of Hawaii Aegis Test Site 26
Potential Contribution from Lasers 26
Technical Risk and Test and Evaluation Issues 27
July 2020 GAO Report 27
January 2021 DOT&E Report 29
Legislative Activity for FY2022 30
Summary of Action on FY2022 MDA Funding Request 30
FY2022 National Defense Authorization Act (H.R. 4350) 31
House 31
FY2022 DOD Appropriations Act (H.R. 4432) 33
House 33

Figures

Figure 1. GAO Summary of Capabilities of Aegis BMD System Variants 3

Tables

Table 1. FY2021-FY2025 MDA Procurement and R&D Funding for Aegis BMD Efforts..... 11
Table 2. Summary of Congressional Action on FY2022 MDA Funding Request 31

Table A-1. Reported Aegis BMD Flight Tests From January 2002 to the Present 34

Appendixes

Appendix. Reported Aegis BMD Flight Tests 34

Contacts

Author Information 36

Introduction

This report provides background information and issues for Congress on the Aegis ballistic missile defense (BMD) program, a program carried out by the Missile Defense Agency (MDA) and the Navy that gives Navy Aegis cruisers and destroyers a capability for conducting BMD operations. The issue for Congress is whether to approve, reject, or modify Department of Defense (DOD) acquisition strategies and proposed funding levels for the Aegis BMD program. Congress's decisions on the Aegis BMD program could significantly affect U.S. BMD capabilities and funding requirements, and the BMD-related industrial base.

Background

Aegis Ships

All but three of the Navy's cruisers and destroyers are called Aegis ships because they are equipped with the Aegis ship combat system—an integrated collection of sensors, computers, software, displays, weapon launchers, and weapons named for the mythological shield that defended Zeus. (The exceptions are the Navy's three Zumwalt [DDG-1000] class destroyers, which are discussed below.) The Aegis system was originally developed in the 1970s for defending ships against aircraft, anti-ship cruise missiles (ASCMs), surface threats, and subsurface threats. The system was first deployed by the Navy in 1983, and it has been updated many times since. The Navy's Aegis ships include Ticonderoga (CG-47) class cruisers and Arleigh Burke (DDG-51) class destroyers.

Ticonderoga (CG-47) Class Aegis Cruisers

A total of 27 CG-47s (CGs 47 through 73) were procured for the Navy between FY1978 and FY1988; the ships entered service between 1983 and 1994. The first five ships in the class (CGs 47 through 51), which were built to an earlier technical standard in certain respects, were judged by the Navy to be too expensive to modernize and were removed from service in 2004-2005, leaving 22 ships in operation (CGs 52 through 73).

Arleigh Burke (DDG-51) Class Aegis Destroyers[1]

A total of 62 DDG-51s were procured for the Navy between FY1985 and FY2005; the first entered service in 1991 and the 62nd entered service in FY2012. The first 28 ships are known as Flight I/II DDG-51s. The next 34 ships, known as Flight IIA DDG-51s, incorporate some design changes, including the addition of a helicopter hangar.

No DDG-51s were procured in FY2006-FY2009. The Navy during this period instead procured the three above-mentioned Zumwalt (DDG-1000) class destroyers. The DDG-1000 design does not use the Aegis system and does not include a capability for conducting BMD operations. Navy plans do not call for modifying the three DDG-1000s to make them BMD-capable.[2]

Procurement of DDG-51s resumed in FY2010, following procurement of the three Zumwalt-class destroyers. A total of 25 DDG-51s have been procured from FY2010 through FY2021. DDG-51s

[1] For more on the DDG-51 program, see CRS Report RL32109, *Navy DDG-51 and DDG-1000 Destroyer Programs: Background and Issues for Congress*, by Ronald O'Rourke.

[2] For more on the DDG-1000 program, see CRS Report RL32109, *Navy DDG-51 and DDG-1000 Destroyer Programs: Background and Issues for Congress*, by Ronald O'Rourke.

procured in FY2017 and subsequent years are being built to a new version of the DDG-51 design called the Flight III version. The Flight III version is to be equipped with a new radar, called the SPY 6 radar (and prior to that, the Air and Missile Defense Radar, or AMDR), that is more capable than the SPY-1 radar installed on all previous Aegis cruisers and destroyers.

Aegis Ships in Allied Navies

Sales of the Aegis system to allied countries began in the late 1980s. Allied countries that now operate, are building, or are planning to build Aegis-equipped ships include Japan, South Korea, Australia, Spain, and Norway.[3] Japan's Aegis-equipped ships are BMD-capable. The Aegis-equipped ships operated by South Korea, Australia, Spain, and Norway are currently not BMD-capable.

Aegis BMD System[4]

Aegis ships are given a capability for conducting BMD operations by incorporating changes to the Aegis system's computers and software, and by arming the ships with BMD interceptor missiles. In-service Aegis ships can be modified to become BMD-capable ships, and DDG-51s procured in FY2010 and subsequent years are being built from the start with a BMD capability.

Versions and Capabilities of Aegis BMD System

Overview

The Aegis BMD system exists in multiple variants whose ascending numerical designations indicate ascending levels of capability. In MDA's FY2022 budget submission, the designations of Aegis BMD system variants have been changed and consolidated to 4.X, 5.X, and 6.X.[5] These BMD system variants correlate with certain versions (i.e., baselines, or BLs) of the overall Aegis system, which have their own numbering system. The more recent BMD variants, in addition to being able to address more challenging BMD scenarios, give BMD-equipped ships a capability to simultaneously perform both BMD operations against ballistic missiles and anti-air warfare (AAW) operations (aka air-defense operations) against aircraft and anti-ship cruise missiles. **Figure 1** provides a 2019 Government Accountability Office (GAO) summary of the capabilities of the more recent BMD variants and their correlation to Aegis system baselines. Because **Figure 1** was prepared in 2019, it uses the older designations for Aegis BMD system variants, rather than the new designations that have been introduced as part of the MDA's FY2022 budget submission.

The Aegis BMD system was originally designed primarily to intercept theater-range ballistic missiles, meaning short-, medium-, and intermediate-range ballistic missiles (SRBMs, MRBMs, and IRBMs, respectively). In addition to its capability for intercepting theater-range ballistic missiles, detection and tracking data collected by the Aegis BMD system's radar might be passed to other U.S. BMD systems that are designed to intercept intercontinental ballistic missiles

[3] The Norwegian ships are somewhat smaller than the other Aegis ships, and consequently carry a reduced-size version of the Aegis system that includes a smaller, less-powerful version of the SPY-1 radar.

[4] Unless stated otherwise, information in this section is taken from MDA briefings on the Aegis BMD program given to CRS and CBO analysts on the MDA's FY2020 and prior-year budget submissions.

[5] The 4.X variant is the new designation for the variants previously designated 3.6.X, 4.0.X, 4.1, and 4.2. The 5.X variant is the new designation for the variants previously designated 5.0CU (with the CU standing for Capability Upgrade) and 5.1. The 6.X variant is the new designation for the variant previously designated 6.0.

(ICBMs), which might support intercepts of ICBMs that are conducted by those other U.S. BMD systems.

Figure 1. GAO Summary of Capabilities of Aegis BMD System Variants

Table 5: Aegis Ballistic Missile Defense (BMD) spirals with associated Aegis Weapons System Baselines and capabilities.

Aegis BMD spirals	Associated integrated Aegis Weapon System Baselines (BL)	Key Ballistic Missile Defense Capabilities	Delivery date
BMD 5.0 Capability Upgrade (CU)	BL 9.C1	• Addition of Standard Missile-3 (SM-3) Block IB Threat Upgrade interceptor • Launch on Remote[a] • Improved discrimination using infrared and radio wave data • Capability against more advanced threats • Ship battle group defense capability using Standard Missile (SM-6) Dual I[b]	2015
	BL 9.B1	• BMD 5.0 CU capabilities for Aegis Ashore in Romania without Standard Missile (SM-6) Dual I	2015
BMD 5.1	BL 9.C2	• Addition of SM-3 Block IIA • Engage on Remote[c] • Ship battle group defense capability using Standard Missile (SM-6) Dual II[b] •	2019
	BL 9.B2	• BMD 5.1 capabilities for Aegis Ashore in Romania and Poland	2019
BMD 4.1	BL 5.4	• Similar capabilities to BMD 5.0 CU capabilities, installed on legacy hardware	2020
BMD 4.2	BL 5.X	• Aegis SPY-1 radar refurbishment for improved tracking capability	2023
BMD 6.0	BL 10.0	• New SPY-6 radar with increased radar capacity and discrimination • Performance against additional threats and larger raids • Improved missile communications	2023

Source: GAO analysis of MDA data | GAO-19-387

[a]Launch on Remote allows Aegis BMD to launch its interceptor on tracks provided by off board sensor before its own radar acquires the threat, but the intercept itself is executed based on onboard the Aegis SPY-1 radar.

[b]SM-6 Dual I and SM-6 Dual II allow ship to defend itself and other nearby ships in a battle group. SM-6 Dual I and II baselines are not included in the Ballistic Missile Defense Accountability Report and thus fall outside the scope of this review.

[c]Engage on Remote increases the area defended by the BMDS, by allowing Aegis BMD to intercept a threat before it is visible to its own radar, based entirely on tracks from a forward-based sensor.

Source: Government Accountability Office, *Missile Defense[:] Delivery Delays Provide Opportunity for Increased Testing to Better Understand Capability*, GAO-19-387, June 2019, Table 5 on p. 31.

April 2021 Press Report About Upcoming Test Against Mock Hypersonic Weapon

An April 14, 2021, press report stated

> The Missile Defense Agency, together with the U.S. Navy, plan to test an SM-6 missile against an "advanced maneuvering threat," a term that has been used in relation to unpowered hypersonic boost-glide vehicles, later this year. The Pentagon says that unspecified versions of the SM-6 have already demonstrated some degree of capability against these types of weapons, examples of which Russia and China have already begun putting to service. A new variant of the SM-6, the Block IB, is already under development and will itself be able to reach hypersonic speeds.
>
> Barbara McQuiston, a senior U.S. official currently performing the duties of the Under Secretary of Defense for Research and Engineering, including mention of the scheduled SM-6 test in her testimony before the Senate Appropriations Committee's Subcommittee on Defense yesterday….

> "MDA [the Missile Defense Agency], in cooperation with the U.S. Navy, demonstrated early capability against maneuvering threats during flight-testing of the Standard Missile (SM)-6 Sea-Based Terminal (SBT) defense, and it will further demonstrate this capability against an advanced maneuvering threat-representative target later this year," according to McQuiston's written testimony. "We will continue to advance our SBT capability to address the regional hypersonic threat and will test that capability in the FY 2024 timeframe."…
>
> This is not the first time the Pentagon has publicly discussed using a variant of the SM-6 for hypersonic defense. In March 2020, Mike Griffin, then the Under Secretary of Defense for Research and Engineering, first revealed that this missile was among those being considered for this role and that there were plans to test one of them against an actual hypersonic boost-glide vehicle sometime in the 2023 Fiscal Year. It's not clear whether the test Griffin was referring to is the one now scheduled for this year or the one that MDA now plans to carry out in the 2024 Fiscal Year.[6]

Aegis BMD Interceptor Missiles

The BMD interceptor missiles used by Aegis ships are the Standard[7] Missile-3 (SM-3) and the SM-6.

SM-3 Midcourse Interceptor

The SM-3 is designed to intercept ballistic missiles above the atmosphere (i.e., exo-atmospheric intercept), in the midcourse phase of an enemy ballistic missile's flight. It is equipped with a "hit-to-kill" warhead, called a kinetic vehicle, that is designed to destroy a ballistic missile's warhead by colliding with it. The current versions of the SM-3 missile include the SM-3 Block IA, the SM-3 Block IB, and the SM-3 Block IIA.[8]

Compared to the Block IA version, the Block IB version has an improved (two-color) target seeker, an advanced signal processor, and an improved divert/attitude control system for adjusting its course. Compared to the Block IA and 1B versions, which have a 21-inch-diameter booster stage at the bottom but are 13.5 inches in diameter along the remainder of their lengths, the Block IIA version has a 21-inch diameter along its entire length. The increase in diameter to a uniform 21 inches provides more room for rocket fuel, permitting the Block IIA version to have a burnout velocity (a maximum velocity, reached at the time the propulsion stack burns out) that is greater than that of the Block IA and IB versions, as well as a larger-diameter kinetic warhead. The United States and Japan cooperated in developing certain technologies for the Block IIA version, with Japan funding a significant share of the effort.[9]

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[6] Joseph Trevithick, "Navy SM-6 Missile Will Attempt To Swat Down A Mock Hypersonic Weapon," *The Drive*, April 14, 2021.

[7] The Standard Missile is so named because it was originally developed, decades ago, as a surface-to-air (i.e., air defense) missile to serve as the common (i.e., standard) successor to the Navy's then-existing collection of Talos, Terrier, and Tartar air defense missiles (which were sometimes referred to collectively as the 3-T missiles).

[8] MDA and Navy plans at one point called for the SM-3 Block IIA to be succeeded by a still-more-capable interceptor called the SM-3 Block IIB. The effort to develop that missile, however, was ended years ago, and MDA at the time was reportedly not pursuing any follow-on capabilities to the SM-3 Block IIA. (See, for example, Justin Doubleday, "Missile Defense Agency Not Pursuing Follow-On to SM-3 Block IIA Interceptor," *Inside the Navy*, October 24, 2016.)

[9] The cooperative research effort was carried out under a U.S.-Japan memorandum of agreement signed in 1999. The effort focused on risk reduction for four parts of the missile: the sensor, an advanced kinetic warhead, the second-stage propulsion, and a lightweight nose cone.

A March 31, 2020, press report stated

> Raytheon and the Missile Defense Agency are exploring options to extend the range of the Standard Missile-3 Block IB—pushing the ballistic missile interceptor to dramatically expand a defended area by allowing the weapon to communicate with off-board radars—a move that would require enhancing one of the Aegis ballistic missile defense system's newest features: Engage-on-Remote….
>
> MDA Director Vice Adm. Jon Hill told Congress earlier this month that the new Engage-on-Remote capability provides "a seven-fold increase in missile defense coverage when compared to an autonomous Aegis platform."[10]

SM-6 Terminal Interceptor

The SM-2 Block IV was MDA's and the Navy's initial sea-based terminal-phase BMD interceptor. It was designed to intercept ballistic missiles inside the atmosphere (i.e., endo-atmospheric intercept), during the terminal phase of an enemy ballistic missile's flight. It was equipped with a blast fragmentation warhead. A limited number of these missiles were produced years ago.[11] The SM-2 Block IV has now been replaced by the SM-6.

The SM-6 is MDA's and the Navy's more capable next-generation sea-based terminal-phase (i.e., endo-atmospheric) BMD interceptor. It is based on the SM-6 air defense missile (the Navy's successor to the SM-2 air defense missile). The SM-6 is a dual-capability missile that can be used for either air defense (i.e., countering aircraft and ASCMs) or ballistic missile defense. A July 23, 2018, press report states the following:

> The Defense Department has launched a prototype project that aims to dramatically increase the speed and range of the Navy's Standard Missile-6 by adding a larger rocket motor to the ship-launched weapon, a move that aims to improve both the offensive and defensive reach of the Raytheon-built system.
>
> On Jan. 17 [2018], the Navy approved plans to develop a Dual Thrust Rocket Motor with a 21-inch diameter for the SM-6, which is currently fielded with a 13.5-inch propulsion package. The new rocket motor would sit atop the current 21-inch booster, producing a new variant of the missile: the SM-6 Block IB.[12]

Numbers of BMD-Capable Aegis Ships

MDA's FY2022 budget submission states that "by the end of FY2022 there will be 48 total BMDS [BMD system] capable ships requiring maintenance support."[13]

BMD-Capable Aegis Destroyers Forward-Homeported in Spain

On October 5, 2011, the United States, Spain, and NATO jointly announced that, as part of the EPAA, four BMD-capable U.S. Navy Aegis destroyers were to be forward-homeported (i.e.,

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[10] Jason Sherman, "After MDA Demonstrates 7x Increase in Defended Area, Raytheon Pitching EOR for Older SM-3s," *Inside Defense*, March 31, 2020.

[11] The inventory of SM-2 Block IVs was created by modifying SM-2s that were originally built to intercept aircraft and ASCMs. A total of 75 SM-2 Block IVs were modified, and at least 3 were used in BMD flight tests through February 2012.

[12] Jason Sherman, "Navy Looking to Increase Range, Speed of SM-6 with Larger Rocket Motor," *Inside the Navy*, July 23, 2018.

[13] Missile Defense Agency, *Fiscal Year 2022 President's Budget, Missile Defense Agency*, May 2021, p. 12. (This is MDA's budget justification book for the Operation and Maintenance, Defense-Wide appropriation account.)

based) at the naval base at Rota, Spain.[14] The initial set of four ships was transferred to Rota in FY2014 and FY2015.[15] They are reportedly scheduled to return to the United States and replaced at Rota by a new set of four BMD-capable U.S. Navy Aegis destroyers in 2020-2022.[16]

Navy officials have said that the four Rota-based ships can provide a level of level of presence in the Mediterranean for performing BMD patrols and other missions equivalent to what could be provided by about 10 BMD-capable Aegis ships that are homeported on the U.S. east coast. The Rota homeporting arrangement thus effectively releases about six U.S. Navy BMD-capable Aegis ships for performing BMD patrols or other missions elsewhere. In February and March 2020, DOD officials testified that DOD is considering forward-homeporting an additional two BMD-capable Aegis destroyers at Rota, which would make for a total of six destroyers at the site.[17] Navy officials have testified that they support the idea.[18]

Aegis Ashore Sites

Two Navy-Operated Sites in Romania and Poland

The land-based version of the Aegis BMD system is called Aegis Ashore. There are two Aegis Ashore sites in Europe—one in Romania, and one in Poland. The sites are intended to help defend Europe against ballistic missile threats from countries such as Iran. Each Aegis Ashore site includes a structure housing an Aegis system that is similar to the deckhouse on an Aegis ship, and 24 SM-3 missiles launched from a relocatable Vertical Launch System (VLS) based on the VLS that is installed in Navy Aegis ships.[19]

The plan to establish the two Aegis Ashore sites in Romania and Poland was announced in 2009, as part of a plan for providing regional BMD defense in Europe called the European Phased Adaptive Approach (EPAA). The Aegis Ashore site in Romania achieved operational certification

[14] "Announcement on missile defence cooperation by NATO Secretary General Anders Fogh Rasmussen, the Prime Minister of Spain, Jose Luis Rodriguez Zapatero and US Defense Secretary Leon Panetta," October 5, 2011, accessed October 6, 2011, at http://www.nato.int/cps/en/SID-107ADE55-FF83A6B8/natolive/opinions_78838.htm. See also "SECDEF Announces Stationing of Aegis Ships at Rota, Spain," accessed August 27, 2020, at https://web.archive.org/web/20120117065346/http:/www.navy.mil/search/display.asp?story_id=63109.

Rota is on the southwestern Atlantic coast of Spain, a few miles northwest of Cadiz, and about 65 miles northwest of the Strait of Gibraltar leading into the Mediterranean. U.S. Navy ships have been homeported at Rota at various points in the past, most recently (prior to the current arrangement) in 1979. (Source: Sam Fellman, "U.S. To Base Anti-Missile Ships in Spain," Defense News, October 10, 2011: 76.)

[15] The four ships are the destroyers *Ross* (DDG-71) and *Donald Cook* (DDG-75), which moved to Rota in FY2014, and the destroyers *Carney* (DDG-64) and *Porter* (DDG-78), which moved to Rota in FY2015.

[16] See, for example, Mallory Shelbourne, "USS Arleigh Burke Arrives in Spain, USS Donald Cook Will Head to Mayport," *USNI News*, April 12, 2021.

[17] See, for example, Paul McCleary, "EUCOM Calls For Two More Ships For Spanish Port," *Breaking Defense*, February 25, 2020; David B. Larter, "Push to Base Six US Navy Destroyers in Spain Could Be Gaining Steam," *Defense News*, March 3, 2020.

[18] See, for example, David B. Larter, "The US Navy's Top Officer Declares Support for Basing 6 Destroyers in Spain," *Defense News*, March 5, 2020; John Vandiver, "Rota to Gain Two US Destroyers by Middle of the Decade, EUCOM Chief Says," *Stars and Stripes*, April 15, 2021.

[19] For additional discussion of the Aegis Ashore sites, see Edward Lundquist, "Aegis Ashore Adapts Sea-Based Missile Defense System to Protect Europe," *National Defense*, September 2016.

in May 2016.[20] The site in Poland began construction in May 2016,[21] and it was initially scheduled to be completed in 2018. Its completion, however, has been delayed by four years, to 2022, due to construction contractor performance issues.[22] An April 2021 GAO report on deliveries and testing of U.S. missile defense systems in FY2020 stated the following:

> According to MDA officials, the Aegis Ashore site in Poland continues to experience delays owing to poor performance by the main construction contractor. Based on MDA's latest estimate of completion no earlier than fiscal year 2022, the site will be between three and four years late. According to MDA, in February 2020, the Army Corps of Engineers (which manages construction at the site) notified the main contractor that earnings from all future invoices would be retained, and released only upon the completion of certain key activities. MDA stated that the contractor did not meet these benchmarks and as a result had not been paid since February 2020.
>
> MDA currently attributes $79 million in cost increases to these delays.[23]

Navy Interest in Divesting Aegis Ashore Sites It Operates

On January 11, 2021, the Chief of Naval Operations (CNO), Admiral Michael Gilday, released a guidance document for the Navy entitled *CNO NavPlan* (with NavPlan being short for navigation plan) that states

> To remain ahead of our competitors, we will divest ourselves of legacy capabilities that no longer bring sufficient lethality to the fight. This includes divestment of experimental Littoral Combat Ship hulls, legacy Cruisers, and older Dock Landing Ships. It also includes divesting non-core Navy missions like Aegis-ashore. Transferring shore-based Ballistic Missile Defense sites to ground forces enables Sailors to focus on their core missions at sea and frees up resources to increase our lethality.[24]

A January 12, 2021, press report states

> The chief of naval operation's new call to focus on sea control and power projection could lead the service to shed other non-core missions the Navy conducts today, such as manning Aegis Ashore missile defense sites.
>
> The biggest problem is, no one else has agreed to take over that mission yet….
>
> … no one else operates Aegis systems today, and no one has yet agreed to take over Aegis Ashore, Rear Adm. Paul Schlise, the director of surface warfare on the CNO's staff (OPNAV N96), said today during a panel presentation at the Surface Navy Association's annual symposium.
>
> "It's been an ongoing discussion in the building here. Right now we've got the Aegis Ashore sites in Europe, and there's discussions about potentially more sites in other places.

---

[20] See, for example, Amy Forsythe, "U.S. Navy Aegis Ashore Base in Romania Hosts NATO Country Ambassadors," Defense Visual Information Distribution Service (DVIDS), November 19, 2019; "Aegis Ashore," Missile Defense Advocacy Alliance, accessed August 27, 2020; US Naval Forces Europe-Africa, "Aegis Ashore Missile Defense System (AAMDS)-Romania Operationally Certified," Defense-Aerospace.com, May 12, 2016.

[21] See, for example, "Aegis Ashore," Missile Defense Advocacy Alliance, accessed August 27, 2020.

[22] See, for example, Rich Abott, "Delayed Poland Aegis Ashore Site Needs Two More Years," *Defense Daily*, February 12, 2020; Jen Judson, "Poland's Aegis Ashore Delayed to 2022 with New Way Forward Coming Soon," *Defense News*, February 18, 2020; Megan Eckstein, "MDA, Army Withholding Pay as Aegis Ashore Poland Construction Still Drags," *USNI News*, March 12, 2020; Seapower staff, "Navy Commissions Naval Support Facility Redzikowo, a Future Aegis Ashore Site," *Seapower*, September 3, 2020.

[23] Government Accountability Office, *Missile Defense[:] Fiscal Year 2020 Delivery and Testing Progressed, but Annual Goals Unmet*, GAO 21-314, April 2021, p. 24.

[24] U.S. Navy, Chief of Naval Operations, *CNO NavPlan*, January 2021, p. 10. See also Richard R. Burgess, "CNO: Divest Aegis Ashore Sites to Ground Forces," *Seapower*, January 11, 2021.

> The general discussion has been, this is not a core Navy mission. Sailors really belong at sea serving in ships. And we've got a good number of highly qualified folks serving in those sites, they're going a great job," he said.
>
> "But I think what the CNO teed up is, is this a core Navy mission? I don't think it is. And so there's been some discussion with the Army. The Army, of course, has some missile defense capability and of course great soldiers that serve in those roles. But they don't have any experience with that [Aegis Combat System], the systems that have been installed or are in progress in Romania and Poland. So that's been a running discussion."
>
> Schlise said the discussion is taking place at the Office of the Secretary of Defense level. Without any final decisions, though, the Navy could not shed Aegis Ashore spending in its most recent budgeting work, the Fiscal Year 2022 request that will come out after the Biden administration comes in and can review it.
>
> "For the purposes of this past budget cycle, it was just kind of tabled. So we'll have to see where that discussion goes. As always, here in the building, it's about money. So if that transition were to be considered and approved for moving forward, to transition it to another service, 'who's going to pay' will of course be part of the discussion," Schlise said.[25]

Japan Planned and Later Canceled Two Sites

Japan had planned to procure and operate two Aegis Ashore systems that reportedly were to be located at Ground Self-Defense Force (GSDF) facilities in Akita Prefecture in eastern Japan and Yamaguchi Prefecture in western Japan, and would be operated mainly by the GSDF (i.e., Japan's army).[26] The two systems reportedly were to be equipped with a new Lockheed-made radar called the Long Range Discrimination Radar (LRDR) rather than the Raytheon-made SPY-6 AMDR that is being installed on U.S. Navy Flight III DDG-51s, and reportedly were to go into operation by 2023.[27] On June 15, 2020, however, Japan announced that it had suspended implementation of its Aegis Ashore initiative due to cost growth and technical concerns.[28] On June 25, 2020, Japan confirmed that it had canceled the plan for deploying the two Aegis Ashore sites.[29] A December 6, 2020, press report stated

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[25] Megan Eckstein, "Navy Wants to Shed Aegis Ashore Mission, But Army Still Hasn't Agreed to Take It," *USNI News*, January 12, 2021.

[26] Yomiuri Shimbun, "Akita, Yamaguchi to Get Aegis Ashore/GSDF Involvement Expected to Strengthen Missile Defense," *The Japan News*, November 11, 2017. See also Kyodo, "Japan Mulling News Missile Interceptor Deployment to Guard Against North Korea," *South China Morning Post*, November 11, 2017.

[27] Anthony Capaccio, "Japan in Talks With U.S. on Buying Aegis Missile Defense," *Bloomberg*, November 7, 2017.

[28] See, for example, Rich Abott, "Japan Suspends Aegis Ashore Due To Technical And Cost Concerns," *Defense Daily*, June 15, 2020; Sam LaGrone, "Japan Backing Away From Aegis Ashore," *USNI News*, June 15, 2020; Mari Yamaguchi, "Japan to Scrap Costly Land-Based US Missile Defense System," *Associated Press*, June 15, 2020; Mike Yeo, "Japan Suspends Aegis Ashore Deployment, Pointing to Cost and Technical Issues," *Defense News*, June 15, 2020; Brad Glosserman, "Canceling Aegis Ashore Raises Problems—and Hopes," *Japan Times*, June 17, 2020.

Prior to the June 15, 2020, announcement, Japan had announced in early May that it would evaluate alternatives to the Akita Prefecture site due to strong local opposition to that site. (Masaya Kato, "Japan's Missile Shield Deployment Scuppered by Local Resistance," *Nikkei Asian Review*, May 7, 2020.)

[29] Mari Yamaguchi (Associated Press), "Japan Confirms It's Scrapping US Missile Defense System," *Defense News*, June 25, 2020; Megan Eckstein, "Japan Officially Ends Aegis Ashore Plans After National Security Council Deliberations," *USNI News*, June 26, 2020.

See also Grant Newsham "Abe's Aegis Ashore Cancellation Doesn't Add Up," *Asia Times*, June 30, 2020; Lucy Craft, "Why Japan Scrapped a $4 Billion Missile Defense Purchase from the U.S.," *CBS News*, July 2, 2020; Tim Kelly, "Explainer: Strike Capability, Other Military Options on Table after Japan's Aegis U-Turn," *Reuters*, July 2, 2020; Jeffrey W. Hornung, "Japan Is Canceling a U.S. Missile Defense System," *Foreign Policy*, July 2, 2020; Bruce

> Japan will put new powerful Aegis radars on warships to upgrade its defences against possible ballistic missiles fired by North Korea after it cancelled plans to deploy them at two ground-based stations, the Asahi newspaper reported.
>
> Prime Minister Yoshihide Suga's government is likely to approve the recommendation by the country's National Security Council before the end of the year, although any decision on type of vessel or cost will be left until next year, the paper said, citing unidentified sources….
>
> Deploying the new Aegis radars could cost twice as much and take up to three years longer to complete than the ground-based versions, which were expected cost of around $2 billion to build, a source with knowledge of the proposal told Reuters earlier….
>
> Fitted with Lockheed Martin Corp SPY-7 radars that will have at least three times the range of older Aegis systems deployed on Japanese navy destroyers, the upgrade will allow Japan to use new interceptor missiles to target warheads in space fired by North Korea or other potential foes, including China and Russia.[30]

An August 19, 2021, press report stated

> A sea-based Aegis missile defense system could be the next program to be abandoned by Tokyo.
>
> The Japanese Defense Ministry does not plan to seek funds for it in the upcoming fiscal 2022 budget. Citing government sources, the Asahi Shimbun newspaper said such a budget request will "likely be impossible over the next few years."[31]

Aegis BMD Development Philosophy and Flight Tests

The Aegis BMD development effort, including Aegis BMD flight tests, has been described as following a development philosophy long held within the Aegis program office of "build a little, test a little, learn a lot," meaning that development is done in manageable steps, then tested and validated before moving on to the next step.[32]

Klingner, "Japan Undercuts Its Defense Against North Korean Missiles," Heritage Foundation, July 22, 2020; Tim Kelly and Yoshifumi Takemoto, "Exclusive: As Japan Weighs Missile-Defence Options, Raytheon Lobbies for Lockheed's $300 Million Radar Deal," Reuters, July 30, 2020; Rieko Miki, "The Price of Peace: Why Japan Scrapped a $4.2bn US Missile System," *Nikkei Asian Review*, August 5, 2020; Loren Thompson, "Japan's Rethink Of Aegis Ashore Could Tie Up Navy, Increase Costs And Cause Big Delays," *Forbes*, August 11, 2020.

On June 18, 2020, it was reported that the United States and Japan were in talks to address the technical issues Japan cited and explore potential paths forward for bolstering Japan's ballistic missile defense capability. See Lara Seligman, "U.S. and Japan in Talks about 'Alternatives' to Aegis Ashore Missile Defense System," *Politico Pro*, June 18, 2020; Idrees Ali, "U.S. in Talks with Japan after Aegis Ashore Missile Defense System Suspension: Official," *Reuters*, June 18, 2020; Jason Sherman, "MDA Hopes to 'Resolve' Japan's Aegis Ashore Concerns, Reinstate Project," *Inside Defense*, June 18, 2020; "U.S. Talking with Japan on Concerns over Halted Missile Defense Plan," *Kyodo News*, June 19, 2020. See also Asahi Shimbun, "Japan Eyes Offshore Options to Replace Aegis Defense System," *Asahi Shimbun*, September 10, 2020.

[30] Reuters staff, "Japan to Put New Aegis Radars on Warships after Cancelling Ground Stations: Asahi," *Reuters*, December 6, 2020. See also Agence France-Presse, "Japan Weighs Ships For Aegis Missile Defence System," *Barron's*, December 9, 2020; Kyodo, "Cabinet Set to Approve Destroyers as Alternative to Aegis Ashore," *Japan Times*, November 28, 2020.

[31] Chen Chuanren, "Japan's Sea-Based Aegis System Faces Ax," *Aviation Week Network*, August 19, 2021.

[32] See, for example, "Aegis BMD: "Build a Little, Test a Little, Learn a Lot," USNI blog, March 15, 2010, accessed September 11, 2013, at http://blog.usni.org/2010/03/15/aegis-bmd-build-a-little-test-a-little-learn-a-lot, and "Aegis Ballistic Missile Defense, Aegis Ballistic Missile Defense Overview for the George C. Marshall Institute, RADM Alan B. Hicks, USN, Aegis BMD Program Director, August 3, 2009, slide 16 of 20, entitled "Some of our Philosophies In a Nutshell (1 of 2)," accessed August 27, 2020, at https://web.archive.org/web/20100706133017/https:/

An April 2021 GAO report on deliveries and testing of U.S. missile defense systems in FY2020 stated the following about testing of the Aegis BMD system:

> In fiscal year 2020, the Aegis BMD program did not conduct any of the six planned flight tests, deleting one and delaying the remaining five. Most notably, a major operational flight test—FTO-03—was deleted, leaving the SM-3 Block IIA interceptor to enter initial production with a single operational flight test. Some flight tests were initially delayed due to range availability and higher priority flights tests (such as FEX-01) and delays were then exacerbated by pandemic-driven travel restrictions. A congressionally mandated flight test—FTM-44—pitting an SM-3 Block IIA interceptor against a simple ICBM, was delayed, but executed in November 2020.
>
> The Aegis BMD program participated in three of five planned ground tests in fiscal year 2020. The two ground tests were delayed due to the pandemic and the unavailability of the Poland Aegis Ashore site, respectively.
>
> All seven cybersecurity tests scheduled for fiscal year 2020 were consolidated into a single test, which was subsequently delayed.[33]

For a summary of reported Aegis BMD flight tests since 2002, see **Table A-1** in **Appendix**.

Allied Participation and Interest in Aegis BMD Program

Japan

Eight BMD-Capable Aegis Destroyers

Japan operates eight BMD-capable Aegis destroyers—the eighth was commissioned into service in March 2021.[34] Japanese BMD-capable Aegis ships have participated in some of the flight tests of the Aegis BMD system using the SM-3 interceptor (see **Table A-1** in **Appendix**).

Cooperative Development of SM-3 Block IIA Missile

Japan cooperated with the United States on development the SM-3 Block IIA missile. Japan developed certain technologies for the missile, and paid for the development of those technologies, reducing the missile's development costs for the United States. A July 6, 2018, press report states that "the U.S. and Japan are looking to jointly develop next-generation radar technology that would use Japanese semiconductors to more than double the detection range of the Aegis missile defense system."[35]

Two Aegis Ashore Sites (Canceled)

As mentioned earlier, Japan had planned to procure and operate two Aegis Ashore systems, but announced in June 2020 that it had canceled the plan.

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www.marshall.org/pdf/materials/743.pdf.

[33] Government Accountability Office, *Missile Defense[:] Fiscal Year 2020 Delivery and Testing Progressed, but Annual Goals Unmet*, GAO 21-314, April 2021, p. 24.

[34] See, for example, Xavier Vavasseur, "Japan Commissions New Maya-Class AEGIS Destroyer JS Haguro はぐろ DDG-180," *Naval News*, March 19, 2021; Yomiuri Shimbun, "Japan Commissions 8th Aegis Destroyer Haguro," *Japan News*, March 20, 2021.

[35] Nikkei staff writers, "US Taps Japan Radar Tech to Double Missile Defense Range," *Nikkei Asian Review*, July 6, 2018.

South Korea

An October 12, 2018, press report states that "the South Korean military has decided to buy ship-based SM-3 interceptors to thwart potential ballistic missile attacks from North Korea, a top commander of the Joint Chiefs of Staff revealed Oct. 12."[36]

Other Countries

Other countries that MDA views as potential naval BMD operators (using either the Aegis BMD system or some other system of their own design) include the United Kingdom, the Netherlands, Spain, Germany, Denmark, and Australia. Spain, South Korea, and Australia either operate, are building, or are planning to build Aegis ships. The other countries operate destroyers and frigates with different combat systems that may have potential for contributing to BMD operations.

FY2022 MDA Procurement and R&D Funding

The Aegis BMD program is funded mostly through MDA's budget. The Navy's budget provides additional funding for BMD-related efforts. **Table 1** shows requested FY2022 MDA procurement and research and development funding for Aegis BMD efforts. (DOD's FY2022 budget submission does not include line-item funding figures for the following four fiscal years.) Research and development funding in the table for the land-based SM-3 is funding for Aegis Ashore sites. MDA's budget also includes additional funding not shown in the table for operations and maintenance (O&M) and military construction (MilCon) for the Aegis BMD program.

Table 1. FY2021-FY2025 MDA Procurement and R&D Funding for Aegis BMD Efforts

(In millions of dollars, rounded to nearest tenth; totals may not add due to rounding)

	FY22 (req.)	FY23 (proj.)	FY24 (proj.)	FY25 (proj.)	FY26 (proj.)
Procurement					
Aegis BMD (line 31)	334.6	n/a	n/a	n/a	n/a
(SM-3 Block IB missile quantity)	*(40)*	*n/a*	*n/a*	*n/a*	*n/a*
Aegis BMD Advance Procurement (line 32)	17.5	n/a	n/a	n/a	n/a
SM-3 Block IIA (line 34)	295.3	n/a	n/a	n/a	n/a
(SM-3 Block IIA missile quantity)	*(8)*	*n/a*	*n/a*	*n/a*	*n/a*
Aegis Ashore Phase III (line 38)	25.9	n/a	n/a	n/a	n/a
Aegis BMD hardware and software (line 40)	81.8	n/a	n/a	n/a	n/a
SUBTOTAL Procurement	**755.1**	**n/a**	**n/a**	**n/a**	**n/a**
Research and development					
Aegis BMD (PE 0603892C) (line 86)	732.5	n/a	n/a	n/a	n/a
Aegis BMD Test (PE 0604878C) (line 118)	117.1	n/a	n/a	n/a	n/a
Land-based SM-3 (PE 0604880C) (line 120)	43.2	n/a	n/a	n/a	n/a
SUBTOTAL RDT&E	**892.8**	**n/a**	**n/a**	**n/a**	**n/a**
TOTAL	**1,647.9**	**n/a**	**n/a**	**n/a**	**n/a**

Source: Table prepared by CRS based on FY2022 MDA budget submission.

[36] Jeff Jeong, "South Korea to Buy Ship-Based Interceptors to Counter Ballistic Missile Threats," *Defense News*, October 12, 2018.

Note: "n/a" means not available—DOD's FY2022 budget submission does not include line-item funding figures for FY2023-FY2026.

Issues for Congress

Annual Funding Request

One issue for Congress is whether to approve, reject, or modify MDA's annual procurement and research and development funding requests for the program. In considering this issue, Congress may consider various factors, including whether the work that MDA is proposing to fund for the fiscal year in question is properly scoped and scheduled, and accurately priced.

COVID-19 Impact

Another issue for Congress concerns the impact of the COVID-19 pandemic on the execution of Aegis BMD program efforts. A DOD point paper on COVID-19 impacts to DOD acquisition programs from March 15, 2020, through June 20, 2020, stated that the impacts included, among other things, "Aegis Program delays: SM-3 Block IIA production deliveries; Aegis Ashore Poland construction (further delays); and Aegis Testing delays for Flight Test Missile (FTM)-44 (Aegis), FTM-31, and FTM-33."[37] An April 2021 GAO report on deliveries and testing of U.S. missile defense systems in FY2020 stated the following:

> Among the Aegis BMD programs, COVID-19 impacts have largely been limited to test delays. SM-3 Block IB and IIA program officials reported no direct impact to their production schedules, although in the case of the SM-3 Block IIA there have been impacts on certain suppliers. AWS program officials reported that some ship-board software upgrades would be delayed due to travel restrictions and isolation requirements.
>
> MDA officials stated that neither the U.S. nor Polish governments imposed any COVID-19 restrictions that would have limited construction activities at the Aegis Ashore site in Poland.[38]

Potential for Intercepting ICBMs

Another issue for Congress is what role, if any, the Aegis BMD program should play in defending the U.S. homeland against attack from ICBMs. With the advent of the SM-3 Block IIA interceptor, DOD is evaluating the potential for the Aegis BMD system to intercept certain ICBMs. Section 1680 of the FY2018 National Defense Authorization Act (H.R. 2810/P.L. 115-91 of December 12, 2017) directed DOD to "conduct a test to evaluate and demonstrate, if technologically feasible, the capability to defeat a simple intercontinental ballistic missile threat using the standard missile 3 block IIA missile interceptor." DOD's January 2019 missile defense review report stated the following:

> The SM-3 Blk IIA interceptor is intended as part of the regional missile defense architecture, but also has the potential to provide an important "underlay" to existing GBIs [ground-based interceptors] for added protection against ICBM threats to the homeland.

[37] Department of Defense, "FY 2020 DoD COVID-19 Response and Stimulus & COVID-19 Recovery Acquisition Contract Cost Overrun," undated point paper, 4 pp., posted at *Inside Defense* on August 6, 2020. For additional discussion of COVID-19 impacts to Navy programs, see CRS Report RL32665, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, by Ronald O'Rourke.

[38] Government Accountability Office, *Missile Defense[:] Fiscal Year 2020 Delivery and Testing Progressed, but Annual Goals Unmet*, GAO 21-314, April 2021, p. 23.

> This interceptor has the potential to offer an additional defensive capability to ease the burden on the GBI system and provide continuing protection for the U.S. homeland against evolving rogue states' long-range missile capabilities.
>
> Congress has directed DoD to examine the feasibility of the SM-3 Blk IIA against an ICBM-class target. MDA will test this SM-3 Blk IIA capability in 2020. Due to the mobility of sea-based assets, this new underlay capability will be surged in a crisis or conflict to further thicken defensive capabilities for the U.S. homeland. Land-based sites in the United States with this SM-3 Blk IIA missile could also be pursued.[39]

On November 16, 2020, MDA announced that the congressionally directed ICBM-intercept flight test, called FTM-44, had been conducted on that date and had resulted in a successful intercept of the ICBM-representative target. MDA stated that "FTM-44, originally scheduled for May 2020, was delayed due to restrictions in personnel and equipment movement intended to reduce the spread of COVID-19. FTM-44 satisfies a Congressional mandate to evaluate the feasibility of the SM-3 Block IIA missile's capability to defeat an ICBM threat before the end of 2020."[40] A November 17, 2020, press report about the flight test stated that "the unarmed ICBM was a replica of a target flown against the Ground-based Midcourse Defense system during a March 2019 flight test that featured a salvo launch of a pair of interceptors."[41] An April 2021 GAO report on deliveries and testing of U.S. missile defense systems in FY2020 stated the following:

> MDA's effort to include the SM-3 Block IIA interceptor in a new "layered" homeland defense against intercontinental ballistic missile (ICBM) threats targeting the U.S. could introduce considerable cost, schedule, and performance uncertainty to a program that has just entered initial production. The GMD weapon system currently provides defense against ICBMs, but this new effort would add the SM-3 Block IIA and THAAD weapon system as layers underneath that provided by GMD. For further details on the GMD and THAAD weapon systems see their respective appendixes.
>
> ICBM intercepts are more challenging than the IRBM intercepts for which the SM-3 IIA was originally designed. MDA's most recent attempt to create a system for intercepting ICBMs, known as the Redesigned Kill Vehicle (RKV), re-used some parts from the SM-3 Block IIA. DOD cancelled the RKV before it could complete development after significant cost and schedule overruns and questions about the ability of the design to overcome specific performance risks. Parts re-used from the SM-3 Block IIA were implicated in some of the RKV's performance shortfalls. Even so, planning for an anti-ICBM capability for the SM-3 Block IIA continued during and even after the RKV's termination.
>
> Achieving such a capability will require surmounting several challenges. According to MDA, during the November 2020 flight test named FTM-44, the SM-3 Block IIA struck a simple ICBM target. This was not an operational test, however, and it was executed under highly favorable conditions. More development work is needed for the SM-3 Block IIA to support a layered homeland defense capability. MDA documents show that the agency now plans to develop and procure an upgraded version of the SM-3 Block IIA for the specific purpose of fulfilling the homeland defense mission.[42]

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[39] Department of Defense, *Missile Defense Review 20*19, released January 17, 2019, p. 55. David Axe, "The U.S. Navy's New Missile Defense Is a Bad Idea," *National Interest,* January 17, 2019.

[40] Missile Defense Agency News release 20NEWS-0003, "U.S. Successfully Conducts SM-3 Block IIA Intercept Test Against an Intercontinental Ballistic Missile Target," November 16, 2020.

[41] Jason Sherman, "SM-3 Block IIA Intercepts ICBM Target, Validating Potential for Homeland Defense 'Underlayer,'" *Inside Defense,* November 17, 2020.

[42] Government Accountability Office, *Missile Defense[:] Fiscal Year 2020 Delivery and Testing Progressed, but Annual Goals Unmet,* GAO 21-314, April 2021, p. 24. See also Jen Judson, "Watchdog Expresses Concern over Using US Navy Interceptor for Homeland Missile Defense," *Defense News,* April 29, 2021.

A May 13, 2021, press report stated

> The Missile Defense Agency proved that a Navy destroyer with a Standard Missile-3 Block IIA can stop a simple intercontinental ballistic missile threat, but more work remains to prove whether this combination could contribute to homeland defense, the MDA director said Wednesday [May 12].
>
> Vice Adm. Jon Hill described the Flight Test Aegis Weapon System (FTM) 44, which took place in the Pacific in November after pandemic-related delays earlier in the year: A simple ICBM target was launched from the Army's Ronald Reagan Ballistic Missile Defense Test Site on the Kwajalein Atoll in the Marshall Islands. Satellites detected the launch, and a slew of satellites and sensors, including on the Pacific Missile Range Facility in Hawaii, tracked the target. Arleigh Burke-class destroyer USS John Finn (DDG-113), positioned hundreds of miles east of Hawaii, launched an SM-3 Block IIA missile from its deck based on its best fire control solution at the time, and the missile itself maneuvered to successfully hit the target as it received more information in flight.
>
> The goal of the test, Hill said while speaking at the annual McAleese FY 2022 Defense Programs Conference, was "to prove that we have the ability to leverage the robustness in the [Aegis] program, so that was really the first test just to see if it's feasible. And we learned a lot."
>
> Hill said the crew of John Finn, with limited data due to limited sensor coverage across the vast Pacific, maneuvered the ship to get the highest probability of kill.
>
> "It maneuvered, shot the missile; lots of uncertainty because of lack of sensor coverage for such a long-range flight where we were doing the exercise. So what we actually saw was a really high divert [from the missile]. So kind of two walkaways from that first test, which is why I think it was really important, was that it was the longest propagated error or uncertainty that we've ever seen in any test. And then we had the highest divert—that meant the [SM-3 IIA] missile was maneuvering to actually take it out, and it still took it out, which is really great," Hill continued.
>
> "In terms of feasibility, did we accomplish the mission? Absolutely. Every test objective achieved in November."
>
> Hill was asked about an April Government Accountability Office report that cited concerns about the Aegis Combat System/SM-3 IIA pairing for the homeland defense mission—as opposed to the regional defense mission it was built for, to protect a high-value asset such as an aircraft carrier from an intermediate-range missile—and whether the simple ICBM target used in the November test was representative of the real world.
>
> "So what's next? What's next is to go against a more complex intercontinental ballistic missile threat, and maybe even change the scenario. This scenario was a defense of Hawaii scenario against a rogue nation—you guess which one out there in the Pacific—and in the future we're going to go to a more complex [threat], and that's within the next couple years," he said.
>
> "So we're still analyzing data from November, and then we're going to make upgrades and changes to the combat system, and we'll make changes to the missile in terms of threat set to take on a higher end class threat."
>
> MDA and the military services would have to further integrate systems together to make this a credible layer in the homeland defense network, Hill said. During the November test, the MDA commanded and controlled the event from the Missile Defense Interoperability and Operations Center in Colorado Springs, Colo., using the Command and Control Battle Management and Communication System (C2BMC) to receive satellite and sensor data and feed it to John Finn, which fired its missile on remote without having access to the sensor data itself. While that worked in a controlled environment, for a permanent homeland defense mission the ship would need to be better integrated into U.S. Northern Command's network to fully share information and targeting data.

> Hill said that Aegis has been integrated to operate with the Terminal High Altitude Area Defense system, and THAAD has been integrated with the Patriot missile defense system, but MDA hasn't integrated all the regional defense systems with homeland defense systems.
>
> Beyond the actual integration and engineering work, Hill added that there was a policy question to answer, too.
>
> "Do we want ships in that role of being off the West Coast … defending against ICBMs as a layer to the Ground-Based Mid-Course Defense? That's an incredible conversation, we're having that now, and it's hard to predict where it will go."
>
> Asked on Thursday during the Naval Postgraduate School's acquisition research symposium if the Navy has the capacity and appetite to use destroyers for homeland defense, Hill said much of it comes down to what ships are available for the mission.
>
> "I think if you asked Gen. [Glen] VanHerck from NORTHCOM about his confidence in defending the nation today, the answer would be confident. But as the threat evolves, right, you start to see a little change in that view. And so it's been viewed for a while that the Navy can play a role in that area, but it becomes an asset problem," Hill said. "There are only so many ships we have up there. And they're multi-mission ships, and they have a lot of roles around the globe to execute."[43]

A June 22, 2021, press report stated

> The Pentagon's No. 2 official has ordered 11 missile interceptors transferred from research and development for possible deployment on Navy ships in the Pacific or European regions after a test in November indicated they could stop an intercontinental ballistic missile.
>
> In the test, the USS John Finn intercepted a mock ICBM intended to simulate one that could be launched at Hawaii by North Korea. The destroyer, operating near Hawaii, fired off one of the Standard Missile-3 model Block IIA interceptors built by Raytheon Technologies Corp. at the target launched from Kwajalein Atoll in the Marshall Islands.
>
> Deputy Defense Secretary Kathleen Hicks informed Congress May 27 of her rationale for transferring the interceptors, although she didn't disclose it publicly.
>
> "The missiles have conducted successful intercept tests and their deployment is in the important interest of our national security," Hicks spokesman Jamal Brown said in an email this month. The transfer to the Navy marks the first major missile defense initiative of the Biden administration.
>
> Although the Navy's Aegis combat system, which launched the missile, and the interceptor "were not designed to defeat an ICBM-class target, this test demonstrated some potential limited capability," Vice Admiral Jon Hill, director of the Missile Defense Agency, said in testimony to Congress last week.[44]

Required vs. Available Numbers of BMD-Capable Aegis Ships

Another potential issue for Congress concerns required numbers of BMD-capable Aegis ships versus available numbers of BMD-capable Aegis ships. Some observers are concerned about the potential operational implications of a shortfall in the available number of BMD-capable relative

[43] Megan Eckstein, "MDA: Test of DDG, Standard Missile-3 IIA a Good Start, But More Work Needed on Homeland Defense Mission," *USNI News*, May 13, 2021. See also Jason Sherman, "MDA Planning Second SM-3 Block IIA Flight Test Against ICBM Target; New Development and Upgraded Interceptor Needed," *Inside Defense*, May 12, 2021; Rich Abott, "MDA Planning Second Test of SM-3 IIA Against ICBM Target," *Defense Daily*, May 17, 2021.

[44] Anthony Capaccio, "U.S. Navy Ships Close to Getting Interceptors That Could Stop an ICBM," *Bloomberg*, June 22, 2021.

to the required number. Regarding the required number of BMD-capable Aegis ships, an August 15, 2018, Navy information paper states the following:

> The [Navy's] 2016 Force Structure Assessment [FSA][45] sets the requirement [for BMD-capable ships] at 54 BMD-capable ships, as part of the 104 large surface combatant requirement, to meet Navy unique requirements to support defense of the sea base and limited expeditionary land base sites….
>
> The minimum requirement for 54 BMD ships is based on the Navy unique requirement as follows. It accepts risk in the sourcing of combatant commander (CCDR) requests for defense of land.
>
> - 30 to meet CVN escort demand for rotational deployment of the carrier strike groups
>
> - 11 INCONUS for independent BMD deployment demand
>
> - 9 in forward deployed naval forces (FDNF) Japan to meet operational timelines in USINDOPACOM
>
> - 4 in FDNF Europe for rotational deployment in EUCOM.[46]

Burden of BMD Mission on U.S. Navy Aegis Ships

A related potential issue for Congress is the burden that BMD operations may be placing on the Navy's fleet of Aegis ships, particularly since performing BMD patrols requires those ships to operate in geographic locations that may be unsuitable for performing other U.S. Navy missions, and whether there are alternative ways to perform BMD missions now performed by U.S. Navy Aegis ships, such as establishing more Aegis Ashore sites. A June 16, 2018, press report states the following:

> The U.S. Navy's top officer wants to end standing ballistic missile defense patrols and transfer the mission to shore-based assets.
>
> Chief of Naval Operations Adm. John Richardson said in no uncertain terms on June 12 that he wants the Navy off the tether of ballistic missile defense patrols, a mission that has put a growing strain on the Navy's hard-worn surface combatants, and the duty shifted towards more shore-based infrastructure.
>
> "Right now, as we speak, I have six multi-mission, very sophisticated, dynamic cruisers and destroyers—six of them are on ballistic missile defense duty at sea," Richardson said during his address at the U.S. Naval War College's Current Strategy Forum. "And if you know a little bit about this business you know that geometry is a tyrant.
>
> "You have to be in a tiny little box to have a chance at intercepting that incoming missile. So, we have six ships that could go anywhere in the world, at flank speed, in a tiny little box, defending land."
>
> Richardson continued, saying the Navy could be used in emergencies but that in the long term the problem demands a different solution.
>
> "It's a pretty good capability and if there is an emergent need to provide ballistic missile defense, we're there," he said. "But 10 years down the road, it's time to build something

[45] The FSA is the Navy's analysis, performed every few years, that establishes the Navy's ship force structure requirements. For further discussion, see CRS Report RL32665, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, by Ronald O'Rourke.

[46] Navy information paper dated August 15, 2018, entitled "Ballistic Missile Defense (BMD) Capable Ships requirement," provided by Navy Office of Legislative Affairs to CBO and CRS on August 15, 2018. The information paper was requested by CBO.

> on land to defend the land. Whether that's AEGIS ashore or whatever, I want to get out of the long-term missile defense business and move to dynamic missile defense."
>
> The unusually direct comments from the CNO come amid growing frustration among the surface warfare community that the mission, which requires ships to stay in a steaming box doing figure-eights for weeks on end, is eating up assets and operational availability that could be better used confronting growing high-end threats from China and Russia.
>
> The BMD mission was also a factor in degraded readiness in the surface fleet. Amid the nuclear threat from North Korea, the BMD mission began eating more and more of the readiness generated in the Japan-based U.S. 7th Fleet, which created a pressurized situation that caused leaders in the Pacific to cut corners and sacrifice training time for their crews, an environment described in the Navy's comprehensive review into the two collisions that claimed the lives of 17 sailors in the disastrous summer of 2017.
>
> Richardson said that as potential enemies double down on anti-access technologies designed to keep the U.S. Navy at bay, the Navy needed to focus on missile defense for its own assets.
>
> "We're going to need missile defense at sea as we kind of fight our way now into the battle spaces we need to get into," he said. "And so restoring dynamic maneuver has something to do with missile defense.[47]

A June 23, 2018, press report states the following:

> The threats from a resurgent Russia and rising China—which is cranking out ships like it's preparing for war—have put enormous pressure on the now-aging [U.S. Navy Aegis destroyer] fleet. Standing requirements for BMD patrols have put increasing strain on the U.S. Navy's surface ships.
>
> The Navy now stands at a crossroads. BMD, while a burden, has also been a cash cow that has pushed the capabilities of the fleet exponentially forward over the past decade. The game-changing SPY-6 air and missile defense radar destined for DDG Flight III, for example, is a direct response to the need for more advanced BMD shooters. But a smaller fleet, needed for everything from anti-submarine patrols to freedom-of-navigation missions in the South China Sea, routinely has a large chunk tethered to BMD missions.
>
> "Right now, as we speak, I have six multimission, very sophisticated, dynamic cruisers and destroyers—six of them are on ballistic missile defense duty at sea," Chief of Naval Operations Adm. John Richardson said during an address at the recent U.S. Naval War College's Current Strategy Forum. "You have to be in a tiny little box to have a chance at intercepting that incoming missile. So we have six ships that could go anywhere in the world, at flank speed, in a tiny little box, defending land."
>
> And for every six ships the Navy has deployed in a standing mission, it means 18 ships are in various stages of the deployment cycle preparing to relieve them.
>
> The Pentagon, led by Defense Secretary Jim Mattis, wants the Navy to be more flexible and less predictable—"dynamic" is the buzzword of moment in Navy circles. What Richardson is proposing is moving standing requirements for BMD patrols away from ships underway and all the associated costs that incurs, and toward fixed, shore-based sites, and also surging the Navy's at-sea BMD capabilities when there is an active threat....
>
> In a follow-up response to questions posed on the CNO's comments, Navy spokesman Cmdr. William Speaks said the Navy's position is that BMD is an integral part of the service's mission, but where long-term threats exist, the Navy should "consider a more persistent, land-based solution as an option."

[47] David B. Larter, "The US Navy Is Fed Up with Ballistic Missile Defense Patrols," *Defense News*, June 16, 2018. See also Paul McLeary, "Will Budget Crunch Pentagon Laser & Space Investments?" *Breaking Defense*, November 13, 2018.

> "This idea is not about the nation's or the Navy's commitment to BMD for the U.S. and our allies and partners—the Navy's commitment to ballistic missile defense is rock-solid," Speaks said. "In fact, the Navy will grow the number of BMD-capable ships from 38 to 60 by 2023, in response to the growing demand for this capability.
>
> "The idea is about how to best meet that commitment. In alignment with our national strategic documents, we have shifted our focus in an era of great power competition—this calls us to think innovatively about how best to meet the demands of this mission and optimize the power of the joint force."...
>
> While the idea of saving money by having fixed BMD sites and freeing up multimission ships is sensible, it may have unintended consequences, said Bryan McGrath, a retired destroyer skipper and owner of the defense consultancy The Ferry Bridge Group.
>
> "The BMD mission is part of what creates the force structure requirement for large surface combatants," McGrath said on Twitter after Defense News reported the CNO's comments. "Absent it, the number of CG's and DDG's would necessarily decline. This may in fact be desirable, depending on the emerging fleet architecture and the roles and missions debate underway. Perhaps we need more smaller, multi-mission ships than larger, more expensive ones.
>
> "But it cannot be forgotten that while the mission is somewhat wasteful of a capable, multi-mission ship, the fact that we have built the ships that (among other things) do this mission is an incredibly good thing. If there is a penalty to be paid in peacetime sub-optimization in order to have wartime capacity—should this not be considered a positive thing?"
>
> McGrath went on to say that the suite of combat systems that have been built into Aegis have been in response to the BMD threat. And indeed, the crown jewels of the surface fleet—Aegis Baseline 9 software, which allows a ship to do both air defense and BMD simultaneously; the Aegis common-source library; the forthcoming SPY-6; cooperative engagement—have come about either in part or entirely driven by the BMD mission....
>
> A Navy official who spoke on condition of anonymity, to discuss the Navy's shifting language on BMD, acknowledged the tone had shifted since the 2000s when the Navy latched onto the mission. But the official added that the situation more than a decade later has dramatically shifted.
>
> "The strategic environment has changed significantly since the early 2000s—particularly in the western Pacific. We have never before faced multiple peer rivals in a world as interconnected and interdependent as we do today," the official said. "Nor have we ever seen technologies that could alter the character of war as dramatically as those we see emerging around us. China and Russia have observed our way of war and are on the move to reshape the environment to their favor."
>
> In response to the threat and Defense Secretary Jim Mattis' desire to use the force more dynamically, the Navy is looking at its options, the official said. "This includes taking a look at how we employ BMD ships through the lens of great power competition to compete, deter and win against those who threaten us."[48]

A January 29, 2019, press report states the following:

> The Navy is looking to get out of the missile defense business, the service's top admiral said today, and the Pentagon's new missile defense review might give the service the off-ramp it has been looking for to stop sailing in circles waiting for ground-based missile launches.
>
> This wasn't the first time Adm. John Richardson bristled in public over his ships sailing in "small boxes" at sea tasked with protecting land, when they could be outperforming other

[48] David B. Larter, "As Threats Mount, US Navy Grapples with Costly Ballistic Missile Defense Mission," *Defense News*, June 23, 2018.

> missions challenging Chinese and Russian adventurism in the South China Sea and the North Atlantic….
>
> "We've got exquisite capability, but we've had ships protecting some pretty static assets on land for a decade," Richardson said at the Brookings Institute. "If that [stationary] asset is going to be a long-term protected asset, then let's build something on land and protect that and liberate these ships from this mission."
>
> Japan is already moving down the path of building up a more robust ground-based sensor and shooter layer, while also getting its own ships out to sea armed with the Aegis radar and missile defense system, both of which would free up American hulls from what Richardson on Monday called "the small [geographic] boxes where they have to stay for ballistic missile defense."[49]

Allied Burden Sharing: U.S. vs. Allied Contributions to Regional BMD Capabilities

Another related potential issue for Congress concerns allied burden sharing—how allied contributions to regional BMD capabilities and operations compare to U.S. naval contributions to overseas regional BMD capabilities and operations, particularly in light of constraints on U.S. defense spending, worldwide operational demands for U.S. Navy Aegis ships, and calls by some U.S. observers for increased allied defense efforts. The issue can arise in connection with both U.S. allies in Europe and U.S. allies in Asia. Regarding U.S. allies in Asia, a December 12, 2018, press report states the following:

> In June, US Navy Chief of Naval Operations (CNO) Admiral John Richardson said during a speech at the US Naval War College that the US Navy should terminate its current practice of dedicating several US Navy warships solely for Ballistic Missile Defense (BMD).
>
> Richardson wanted US warships to halt BMD patrols off Japan and Europe as they are limiting, restrictive missions that could be better accomplished by existing land-based BMD systems such as Patriot anti-missile batteries, the US Terminal High Altitude Area Defense (THAAD) anti-missile system and the Aegis Ashore anti-missile system.
>
> In the months since dropping his bombshell, Richardson—and much of the debate—has gone quiet.
>
> "My guess is the CNO got snapped back by the Pentagon for exceeding where the debate actually stood," one expert on US naval affairs told Asia Times.
>
> But others agree with him. Air Force Lt Gen Samuel A Greaves, the director of the US Missile Defense Agency (MDA), acknowledges Richardson's attempts to highlight how these BMD patrols were placing unwelcome "strain on the (US Navy's) crews and equipment."
>
> But there are complications. While it may free US Navy warships for sea-control, rather than land defense, there is a concern that next-generation hypersonic cruise missiles could defeat land-based BMD systems, such as Aegis Ashore, while the US Navy's Aegis-equipped warships offer the advantages of high-speed mobility and stealth, resulting in greater survivability overall.
>
> As Japan prepares to acquire its first Aegis Ashore BMD system – and perhaps other systems such as the THAAD system which has been deployed previously in Romania and

[49] Paul McLeary, "The Navy Has Had Enough of Missile Defense And Sees Its Chance," *Breaking Defense*, January 28, 2019.

> South Korea – the possibility that the US Navy will end its important BMD role represents abrupt change….
>
> Japan's decision to deploy Aegis Ashore can fill in any gap created by a possible US Navy cessation of BMD patrols. "The land-based option is more reliable, less logistically draining, and despite being horrendously expensive, could be effective in the sense that it provides a degree of reassurance to the Japanese people and US government, and introduces an element of doubt of missile efficacy into [North Korean] calculations," said [Garren Mulloy, Associate Professor of International Relations at Daito Bunka University in Saitama, Japan], adding, however, that these systems could not cover Okinawa.
>
> "Fixed sites in Japan could be vulnerable, and the Aegis vessels provide a flexible forward-defense, before anything enters Japanese airspace, but with obviously limited reactions times," Mulloy said. "Aegis Ashore gives more reaction time – but over Japanese airspace."…
>
> The silence about this sudden possible shift in the US defense posture in the western Pacific is understandable: it is a sensitive topic in Washington and Tokyo. However, the Trump administration has urged its allies to pay more for their own defense needs and to support US troops deployed overseas.
>
> Meanwhile, Tokyo needs to proceed cautiously given the likelihood that neighbors might view a move on BMD as evidence that Tokyo is adopting an increasingly aggressive defense posture in the region.
>
> But for them, it is a no-win situation. If the US does ditch the BMD patrol mission, China and North Korea might view the shift as equally menacing given that it greatly enhances the US Navy's maritime warfare capabilities.[50]

Potential Aegis Ashore Site on Guam

Another issue for Congress is whether to procure and install an Aegis Ashore system on Guam. A July 21, 2020, press report stated

> The head of U.S. Indo-Pacific Command told reporters today he wants the Aegis Ashore ballistic missile defense system to bolster the defense of Guam from Chinese missiles.
>
> The Aegis Ashore Baseline 10 system should be "the backbone of [a] homeland defense system" for Guam, Adm. Phil Davidson said during a Defense Writers Group virtual roundtable.
>
> "The reason I'm a key advocate for that is first: it is technology that is available to us now and could be delivered by 2026, when I believe the threat will require us to have a much more robust capability than the combination of [Terminal High Altitude Area Defense], which is deployed there now, and an Aegis ship in response can provide," Davidson said.
>
> Davidson said the current defense system for Guam is not adequate to thwart potential Chinese missiles.
>
> "When you look at the way the threat capability, threat capacity, is manifesting from China in the future—whether it's ballistic missiles from the land or whether it's ballistic or cruise missiles from air and maritime platforms—you are going to need a complete clock, a 360-degree coverage in order to help defend Guam," the admiral said.[51]

[50] Peter J. Brown, "Japan, US Silent over Ending Ballistic Missile Patrols," *Asia Times*, December 12, 2018.

[51] Mallory Shelbourne, "Protecting Guam from Chinese Missiles is Top Priority for INDO-PACOM's Davidson," *USNI News*, July 21, 2020. See also Mandy Mayfield, "Web Exclusive: Commander Wants Aegis Ashore Funding to Defend Guam," *National Defense*, July 21, 2020; Jason Sherman, "INDOPACOM: Aegis Ashore with SPY-6 Needed on Guam by 2026 to Counter Chinese Ballistic, Cruise Missiles," *Inside Defense*, July 21, 2020; and Aaron Mehta,

A September 18, 2020, press report states

> Guam urgently needs an Aegis Ashore missile defense system to protect vital military assets from an increasingly aggressive China, according to the head of U.S. Indo-Pacific Command.
>
> "There are billions of dollars in defense capability on Guam," Adm. Phil Davidson said Thursday [September 17] during an online forum organized by the Missile Defense Advocacy Alliance. "There needs to be some investment in defending that."
>
> The U.S. territory is home to air and naval bases and serves as a launching point for strategic bombers. The Navy is also building facilities to house a Marine Corps air-ground task force to accommodate a planned drawdown of Marines on Okinawa….
>
> China's ability to launch missiles from submarines ranging farther from shore means Guam needs the 360-degree protection that Aegis can provide, he said.
>
> Guam's Terminal High Altitude Area Defense, or THAAD, missile defense battery can sense targets only within a 120-degree range, and it's pointed at North Korea, Davidson said.
>
> "It's going to require a much deeper 360-degree persistent capability," he said, adding that it's important to invest in Guam's missile defense now.
>
> "It is not necessarily about designing or creating a defensive system that is impenetrable or invulnerable against the entire missile inventory of a potential adversary. Rather it is about developing a combat credible deterrent."
>
> INDOPACOM, in a report to Congress, put the cost of a system providing 360-degree air-missile defense on Guam at just under $1.7 billion.
>
> Davidson has requested funding for the system starting in the next fiscal year as part of a Pacific Deterrence Initiative that parallel's a similar program in Europe designed to deter Russia.
>
> Building Aegis Ashore is a pathway to defending against hypersonic missiles, Davidson said, adding that China's rocket force fires and exercises more often than that of any other nation….
>
> Rapidly growing capability in China and North Korea requires that Aegis be the starting point for the defense of Guam, Davidson said.
>
> "We can't … wait for some perfect solution to manifest itself in 2035 or 2040. We are in the threat environment now," he said.[52]

A September 22, 2020, press report states

> The Aegis Ashore ballistic missile defense system being eyed to bolster protection of Guam could potentially be armed for strike missions to offset China's current ballistic and cruise missile advantage against U.S. forces, according to the top U.S. military official in the region.
>
> Adm. Phil Davidson, commander of U.S. Indo-Pacific Command, broached the possibility of using Aegis Ashore for offense during a Sept. 17 online discussion hosted by the Missile Defense Advocacy Alliance, acknowledging a capability the Defense Department

"INDOPACOM Head Wants Aegis Ashore in Guam by 2026," *Defense News*, July 22, 2020. See also Bradley Bowman and Maj. Shane Praiswater, "Guam needs Aegis Ashore," *Defense News*, August 25, 2020.

[52] Seth Robson, "Indo-Pacific Command Leader Underscores Need for Stronger Missile Defense on Guam," *Stars and Stripes*, September 18, 2020.

> disavowed for years while the Intermediate-Range Nuclear Forces (INF) Treaty remained in force.[53]

Other observers have argued that an Aegis Ashore site at Guam would not be the most cost-effective option for bolstering Guam's defenses against potential missile attacks. A July 30, 2020, opinion article states

> The head of U.S. Indo-Pacific Command said last week his top priority is establishing an Aegis Ashore system on Guam by 2026. New air defenses will help protect U.S. citizens and forces in Guam; but as Japan's government found, Aegis Ashore may not be the best option to protect military and civilian targets from growing and improving Chinese and North Korean missile threats….
>
> Although the current Terminal High Altitude Area Defense battery on Guam can defend against some ballistic missiles, its single AN/TPY-2 radar is vulnerable and cannot provide 360-degree coverage. Moreover, THAAD's focus on high altitudes makes it a poor fit to defeat lower-flying aircraft or cruise missiles that would likely be used by China's military against Guam. The island needs a new air defense architecture.
>
> Aegis Ashore is highly capable, but has its own limitations. Designed primarily to counter small numbers of ballistic missiles, its fixed missile magazine and radar would be vulnerable to attack and would fall short against the bombardment possible from China.
>
> Instead of installing one or more Aegis Ashore systems on Guam, a more effective air and missile defense architecture would combine the latest version of the Aegis Combat System with a disaggregated system of existing sensors, effectors, and command-and-control nodes. A distributed architecture would also be scalable, allowing air and missile defenses to also protect U.S. citizens and forces operating in the Northern Marianas.
>
> Guam's geography enables longer-range sensing than would be possible from a ship or a single Aegis Ashore radar. Fixed, relocatable and mobile radio frequency sensors should be positioned around the island's perimeter, such as compact versions of SPY-6 or Lower Tier Air and Missile Defense Sensor radars and the passive Army Long-Range Persistent Surveillance system. During periods of heightened tension, passive and active radio frequency and electro-optical/infrared sensors could also be deployed on unmanned aircraft and stratospheric balloons to monitor over-the-horizon threats. This mixed architecture would provide better collective coverage and be more difficult to defeat compared to one or two fixed Aegis Ashore deckhouses.
>
> To shoot down enemy missiles and aircraft, the architecture should field mobile, containerized launchers for long-range interceptors like the SM-6 and SM-3 rather than Aegis Ashore's finite and targetable in-ground vertical launch magazines. They should be complemented by medium- to short-range engagement systems to protect high-value targets such as the Patriot, the National Advanced Surface-to-Air Missile System or the Army's planned Indirect Fire Protection Capability, as well as non-kinetic defenses such as high-powered microwave weapons and electronic warfare systems that could damage or confuse the guidance systems on incoming missiles.
>
> Today, destroyers patrol the waters around Guam to provide ballistic missile defense capacity beyond that available with THAAD. A new distributed architecture would place more capacity ashore to free surface combatants from missile defense duty. In a crisis or conflict, the architecture could add capacity with surface action groups and combat air patrols capable of intercepting threats at longer ranges.
>
> Instead of Aegis Ashore's large, single C2 node, a distributed architecture would virtualize the Aegis Combat System to allow multiple facilities or mobile vehicles to serve as miniature air operations centers. The mobility of sensors, effectors and C2 nodes in this

[53] Jason Sherman, "INDOPACOM Chief: Aegis Ashore Guam Could One Day Be Armed for Strike to Counter China," *Inside Defense*, September 22, 2020.

> architecture would enable the employment of camouflage, concealment and deception, including decoys, to complicate enemy targeting and increase the number of weapons needed to ensure a successful attack.
>
> INDOPACOM's plan for implementing new Guam air defenses should also apply lessons from Japan's aborted Aegis Ashore program, whose accelerated timeline contributed to the selection of the least expensive and technically risky option—two fixed Aegis Ashore systems—and the discounting of alternatives. Adm. Phil Davidson's 2026 goal of improving Guam's defenses faces a similar risk.
>
> Bound by an iron triangle, Guam's air and missile defenses can be good, fast or cheap—but not all three. If 2026 is held as a rigid constraint, the only solution able to meet the schedule and requirements may be the familiar, and ineffective, fixed Aegis Ashore architecture.
>
> Compared to one or two Aegis Ashore sites, a distributed architecture may require slightly more time to develop or funds to field. But a phased approach could introduce new systems as funding becomes available and allow expanding the system's capability to meet the evolving threat. For example, SPY-6 radars, C2 bunkers and composite THAAD-Patriot-NASAMS batteries could be fielded before 2026, quickly followed by the introduction of mobile assets.
>
> Guam and the Northern Marianas are essential to U.S. strategy and operations in the Western Pacific. Their defenses have long been ignored, and Adm. Davidson should be lauded for charting a path forward. A disaggregated architecture, however, will be more likely to realize INDOPACOM's vision of resilient and scalable air and missile defense.[54]

A March 4, 2021, press report stated

> Building an Aegis Ashore facility on Guam would relieve three guided-missile destroyers from missile defense work and make them available for Navy tasking, the head of U.S. Indo-Pacific Command said Thursday [March 4].
>
> Speaking at a virtual event hosted by the American Enterprise Institute, Adm. Phil Davidson made the case for building a homeland missile defense system on Guam, which he has said is his top priority, to protect the U.S. territory from Chinese missiles.
>
> "The Guam defense system brings the same ability to protect Guam and the system itself as the three DDGs it would otherwise take to carry out the mission," Davidson said. "We need to free up those guided-missile destroyers, who have multi-mission capability to detect threats and finish threats under the sea, on the sea and above the sea, so that they can move with a mobile and maneuverable naval forces that they were designed to protect and provide their ballistic missile defense."…
>
> "It's return on investment," Davidson said when arguing for the missile defense system.
>
> "For the cost it takes to build that facility and flesh it out, I free up at least three ships in conflict and probably more ships in crisis. You know, in the deterrence phase they keep up a rotation and do all that kind of stuff going forward," he added, referring to the oft-cited notion that it takes three ships total to keep one deployed forward due to the cycle for maintenance, training and operations.
>
> The INDOPACOM chief emphasized that Guam's current use of the Army's Terminal High Altitude Area Defense (THAAD) system paired with an Aegis destroyer is not sufficient to address the threat posed by China.
>
> "It doesn't provide for a 360-degree defense necessarily," he said. "It's really designed to defend against a rogue shot from North Korea."

[54] Timothy A. Walton and Bryan Clark, "Guam's Air Defense Should Learn Lessons from Japan's Aegis Ashore," *Defense News*, July 30, 2020.

> Davidson pointed to China's submarines and surface ships circumnavigating the Northern Mariana Islands and Guam, arguing these actions show that China's ballistic missiles, cruise missiles and potential anti-ship ballistic missiles pose "a 360-degree threat" to Guam.
>
> "We must evolve the critical defense of our people, our platforms and our posture initiatives, and it begins in Guam. Now, a highly capable, fully adaptable and proven system like Aegis – established in a fixed location like Guam – will deliver persistent, 360-degree integrated air and missile defense from the second island chain," he said.[55]

A March 9, 2021, press report stated

> Warning that China's missile arsenal threatens Guam and the United States will have to "fight for it," the head of Indo-Pacific Command pitched lawmakers on building an Aegis Ashore missile defense facility to guard the U.S. territory.
>
> Adm. Phil Davidson told the Senate Armed Services Committee Tuesday [March 9] that the island needs protection as the home of 170,000 U.S. citizens and service members, a deepwater strategic port, fuel and munition stores and an airfield used to project U.S. power. Guam would be key to responding to any conflict in the Asia-Pacific region.
>
> "Guam is a target today. It needs to be defended, and it needs to be prepared for the threats that will come in the future," Davidson said. He added later: "China's own Air Force has put out a propaganda video showing their H-6 bomber force attacking Andersen Air Force Base at Guam and distributed that quite publicly."
>
> While an Aegis Ashore system would counter ballistic missiles or cruise missiles launch from the air, land and sea, the island's existing anti-ballistic missile capability—the Terminal High Altitude Area Defense system—"is not capable of meeting the current trajectory of threats from China," Davidson said.
>
> "It's the key piece that we're missing, that signals to the region that the U.S. is a reliable and committed security partner, that we are there to defend not only U.S. territory but our interests abroad," Davidson said of Aegis Ashore. He added it would show China it "can't knock Guam out with an easy shot and keep us out of the fight to present a fait accompli" against Taiwan.
>
> Davidson has previously said the $1.6 billion system is his top priority among $27 billion in spending he's proposed to continue a broader Pacific Deterrence Initiative through 2027….
>
> The proposed Guam Defense System would consist of Lockheed Martin's Aegis Combat System Baseline 10; a solid-state radar such as the Raytheon SPY-6 or a variant of the Lockheed SPY-7; the BAE Systems Mark 41 Vertical Launching System, and SM-3 or SM-6 Missile, made by Raytheon.
>
> Davidson argued in written testimony that the Army's Integrated Air and Missile Defense Battle Command System and the Air Force's Advanced Battle Management System wouldn't fit the bill because they "are not yet fully developed." Any "recommendations for additional studies, including a requirement for only mobile systems, disregard the immediacy and complexity of the threat (2026) and the absolute need to integrate fires across the region from a forward multi-domain command and control node west of the International Date Line," he said.[56]

[55] Mallory Shelbourne, "Davidson: Aegis Ashore on Guam Would 'Free Up' 3 Navy Destroyers," *USNI News*, March 4, 2021.

[56] Joe Gould, "'Guam Is a Target Today.' Pacific Chief Pitches Aegis Ashore to Congress," *Defense News*, March 9, 2021. See also Jason Sherman, "Pentagon Begins Work on Aegis Ashore for Guam," *Inside Defense*, March 9, 2021.

A June 24, 2021, press report stated

> The head of the U.S. Missile Defense Agency has suggested that portions of a future Aegis Ashore site on the strategic American island of Guam in the Pacific could go into bunkers underground or onto mobile platforms. Ostensibly, this is due to Guam's terrain and limited overall space, but it also speaks to the potential vulnerabilities of such a facility, especially in a major conflict with a near-peer adversary, such as China.
>
> The Missile Defense Agency's (MDA) director, U.S. Navy Vice Admiral Jon Hill, provided these and other details about the current state of plans for an Aegis Ashore capability on Guam at an event that Center for Strategic and International Studies (CSIS) think tank hosted earlier this week. U.S. military officials have publicly said in the past that their goal is for this site, whatever its configuration might be in the end, to be operational by 2026.
>
> "I can see Aegis being underground or mobile," Hill said. "It's not new science separating radars from weapons."
>
> The existing "Aegis Ashore may not be sufficient," he added, referring to the general structure of the existing and planned sites.[57]

An August 23, 2021, report by one observer recommended repurposing some Aegis cruisers that the Navy, as part of its FY2021 budget submission, has proposed for retirement as interim missile defense platforms for Guam, Palau, and Saipan, pending the deployment of more permanent missile-defense systems for these locations. The report stated that

> there are options that could be deployed to Guam today, which would measurably complicate Chinese operational thinking in attacking and suppressing Guam. First, there are three aging BMD-capable Ticonderoga-class cruisers (the CG-73, the CG-72, and the CG-61) that the Navy has slated for decommissioning in 2022 due to high operational cost. Their older analog radar systems, while still capable, have a limited capacity for engaging multiple targets and require auxiliary systems to cool associated electronics. Second, the cruise missile threat could be addressed by repurposing elements of the Army's Counter Rocket, Artillery, and Mortar (C-RAM) systems.
>
> Ticonderoga-class cruisers were designed to provide air defense to carrier strike groups, with later upgrades that enabled ballistic missile defense. As retired Admiral and ex-Commander of INDOPACOM Harry Harris recently argued, any future defense system for Guam must be integrated across numerous systems—these cruisers do that already. Early in their lifetime, these cruisers got the upgrades and space needed to support an Area Air Defense Commander with associated communications, sensors, and weapons. With this in mind, these ships could serve as an operational test bed for integrating newer systems, such as the Army's highly capable TPY-2 radar, into the targeting of the 120 missiles carried in the cruiser's vertical launch system....
>
> Typically, when the Navy deploys a BMD warship to defend Guam, it loiters in waters near the island or moored in port. Guam offers several protected anchorages that a moored BMD-capable cruiser could move between without having to conduct prolonged navigation. This potentially obviates the need for the Navy to man or maintain these ships for independent at-sea operations—potentially escorted or towed between mooring sites. This would enable putting the ship's propulsion system in a state of reduced operational readiness and reducing the crew, but to be clear, cost savings is a secondary consideration to sustaining weapons capacity for defense (and potentially strike)....

[57] Joseph Trevithick, "Guam's New Aegis Ashore Missile Defense System Could Go Underground And Mobile," *The Drive*, June 24, 2021. See also Harry Harris, "Aegis Ashore Too Limited For Guam: Former INDO-PACOM Head," *Breaking Defense*, July 9, 2021; Bradley Bowman and Mark Montgomery, "Fully Fund the Guam Defense System," *War on the Rocks*, July 29, 2021.

> Finally, there is further utility of these ships given recent offers by the government of Palau to host U.S. forces, and increased U.S. attention on the Commonwealth of the Northern Mariana Islands, specifically Saipan and Tinian, for a diversion airfield supporting forward operations. As in Guam, mooring these cruisers at Palau and Saipan can set the foundation for a regional defense network that can mature over time, as more capable systems come online....
>
> While neither C-RAM nor repurposing of aged BMD-capable cruisers represents a long-term solution to the defense of Guam, together with THAAD, they do significantly improve it. In the near term, these cruisers could provide added firepower, sensor coverage, and a platform for integrated air and missile defense command and control until follow-on dedicated systems arrive. Doing this also frees up three front-line AEGIS-equipped destroyers for a range of other pressing missions.[58]

Conversion of Hawaii Aegis Test Site

Another potential issue for Congress is whether to convert the Aegis test facility in Hawaii into an operational land-based Aegis BMD site. DOD's January 2019 missile defense review report states, in a section on improving or adapting existing BMD systems, that

> Another repurposing option is to operationalize, either temporarily or permanently, the Aegis Ashore Missile Defense Test Center in Kauai, Hawaii, to strengthen the defense of Hawaii against North Korean missile capabilities. DoD will study this possibility to further evaluate it as a viable near-term option to enhance the defense of Hawaii. The United States will augment the defense of Hawaii in order to stay ahead of any possible North Korean missile threat. MDA and the Navy will evaluate the viability of this option and develop an Emergency Activation Plan that would enable the Secretary of Defense to operationalize the Aegis Ashore test site in Kauai within 30 days of the Secretary's decision to do so, the steps that would need to be taken, associated costs, and personnel requirements. This plan will be delivered to USDA&S, USDR&E, and USDP within six months of the release of the MDR.[59]

A January 25, 2019, press report states the following:

> The Defense Department will examine the funding breakdown between the Navy and the Missile Defense Agency should the government make Hawaii's Aegis Ashore Missile Defense Test Center into an operational resource, according to the agency's director.
>
> "Today, it involves both Navy resources for the operational crews—that man that site—as well as funds that come to MDA for research, development and test production and sustainment," Lt. Gen. Sam Greaves said of the test center when asked how the funding would shake out between the Navy and MDA should the Pentagon move forward with the recommendation.[60]

Potential Contribution from Lasers

Another potential issue for Congress concerns the potential for ship-based lasers to contribute in coming years to Navy terminal-phase BMD operations and the impact this might eventually have on required numbers of ship-based BMD interceptor missiles. Another CRS report discusses the

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[58] Brent D. Sadler, *Repurposing Navy Cruisers Planned for Decommissioning: An Interim Capability for Countering Chinese Missile Attacks on Guam*, Heritage Foundation, August 23, 2021, pp. 4-5.

[59] Department of Defense, *Missile Defense Review 2019*, released January 17, 2019, pp. 55-56.

[60] Mallory Shelbourne, "DOD to Determine Funding Breakdown for Aegis Ashore Repurposing," *Inside the Navy*, January 25, 2019.

potential value of ship-based lasers for performing various missions, including, potentially, terminal-phase BMD operations.[61]

Technical Risk and Test and Evaluation Issues

Another potential oversight issue for Congress is technical risk and test and evaluation issues in the Aegis BMD program.

July 2020 GAO Report

A July 2020 GAO report on the testing of U.S. BMD systems, including the Aegis BMD system, stated the following:

> Aegis BMD demonstrated various capabilities in fiscal year 2019 tests and achieved independent accreditation for all its models used in operational ground tests. The Missile Defense Agency (MDA) conducted five Aegis Ballistic Missile Defense (BMD) intercept flight tests in fiscal year 2019, successfully intercepting two ballistic missile targets and three cruise missiles. Additionally, MDA also conducted Aegis BMD non-intercept flight tests with live or simulated interceptors and targets, as well as five model-based ground tests that provided data on Aegis BMD interoperability and weapon system functionality in various regional and Homeland Defense scenarios….
>
> Aegis BMD testing also had some limitations. For instance, while most testing limitations are classified, DOT&E noted in its fiscal year 2019 assessment of Aegis BMD that MDA ground tests have routinely shown the need for improved inter-element coordination and interoperability to enhance engagement efficiency. Moreover, for the second year in a row, DOT&E noted that flight testing and models and simulations did not address all expected threat types, ground ranges, and raid sizes for Aegis BMD. For instance, while Aegis BMD M&S tools were accredited for many scenarios, there were limitations for raid engagements due to the lack of validation data from live fire raid engagements and lack of post-intercept debris modeling. As we reported in June 2019, MDA planned to assess Aegis BMD 5.1 raid performance for the first time in December 2018, but the test was de-scoped to a single intercept due, in part, to a test range safety asset malfunction. While MDA planned to conduct a raid the fourth quarter of fiscal year 2020, according to technical comments we received from MDA at the end of our audit, that plan has been canceled. In the meantime, the warfighter will have reduced information about how Aegis BMD 5.1 performs in these real-world-like scenarios.
>
> MDA stayed on track to deliver the next generation of Aegis BMD capabilities. For instance, MDA plans to deliver BMD 6.0 in the 2023 time frame to provide capabilities against larger raids, better discrimination, and improved communication with its interceptors. Additionally, BMD 6.0 takes advantage of the Navy's effort to replace the Aegis AN/SPY-1 radar with a more capable AN/SPY-6 (V)1 and to overhaul the entire Aegis combat system. As we reported in June 2019, MDA and the Navy re-planned AWS Baseline 10.0, after a funding reduction of $31.45 million against BMD 6.05. While the reduction resulted in delays to completion of some technical content, its delivery time frame did not change. In fiscal year 2019, the program remained on schedule, completing a planned review and participated in a Navy-funded developmental test of AN/SPY-6(V)1 and FTX-34, demonstrating ballistic missile tracking capabilities. MDA efforts to deliver integrated AWS Baseline 5.4 were also on track in fiscal year 2019 after the program readjusted its schedule in fiscal year 2018….

[61] See CRS Report R44175, *Navy Lasers, Railgun, and Gun-Launched Guided Projectile: Background and Issues for Congress*, by Ronald O'Rourke.

According to MDA, the Aegis BMD SM-3 Block IB program considers the schedule for awarding a multi-year procurement contract, and enduring subcontractor quality issues, to be the two main risks facing the program. MDA officials stated that they expected to award the multi-year procurement contract in the first quarter, fiscal year 2020. MDA had also stated that a delay in the award could cause production delays both to the United States and to foreign military sales. MDA's current plans call for the multi-year procurement award in the second quarter, fiscal year 2020.

In addition, as we reported in 2019, MDA officials have noted that the Aegis BMD SM-3 Block IB's prime contractor has had difficulty ensuring that all subcontracted components meet defined specifications. Similar issues occurred in fiscal year 2019, each of which required resolution on a case-by-case basis. For example, MDA officials reported that an important actuator was found to have contaminated lubricant, requiring the source of the contamination to be tracked to a specific facility within the supply chain and the procurement of new hardware. In addition, a divert valve was experiencing an increased reject rate, slowing down deliveries of the Third Stage Rocket Motor. The program and the contractor developed and implemented three corrective actions to address this issue and accelerate deliveries. Even so, problems such as these can result in months-long delays, and MDA reported that the introduction of improved quality controls drove up costs in fiscal year 2019….

Following the failure of FTM-29 in January 2018, MDA re-organized the SM-3 Block IIA schedule to allow it to identify the cause of the failure, implement changes, and then test these changes to validate their efficacy. As we reported in May 2019, as a result of the test failure, MDA and the government of Japan convened a failure review board to investigate the causes of the test failure. The board's conclusions identified the source of the failure.

To test the fixes identified through the FTM-29 failure review board, MDA added a new flight test to its schedule, FTM-45. Despite criticism from Department of Defense stakeholders that FTM-45 would not be taxing enough to make up for the failure of FTM-29, MDA successfully conducted the test, and thus validated the corrective actions, in October 2018.

Two months later, in December 2018, MDA conducted FTI-03, the first successful SM-3 Block IIA intercept of an Intermediate-Range Ballistic Missile (IRBM), and the first successful SM-3 Block IIA intercept to use remote sensor data to guide the engagement, known as Engage on Remote. However, as mentioned previously, the test's initial plan was an intercept of two targets, but it was scaled down due to range safety issues.

MDA achieved its objective in FTI-03 by intercepting the target, but a more detailed review of the system's performance revealed at least one issue. During the interceptor's flight, the attitude control system in the third stage rocket motor experienced a fault whereby a valve failed to respond to electronic instructions. A failure review board isolated the fault to a specific component failing to provide adequate electric current. Seeking to avoid unnecessary work, the prime contractor temporarily suspended its operations in order to identify the root cause and then develop and implement corrective actions. This suspension has affected delivery schedules for both third stage rocket motors and completed interceptors.

MDA originally planned for an initial production decision in December 2018, but two issues delayed this decision. First, owing to the fact that the canceled Redesigned Kill Vehicle re-used parts from the SM-3 Block IIA program, the Undersecretary of Defense for Research and Engineering requested a study to determine if the SM-3 Block IIA could be affected by the issues which resulted in the RKV's cancellation. Second, DOD officials recommended against any initial production decision until the issue observed in FTI-03 was resolved.

MDA documents indicated that its officials believed an initial production decision was possible before the end of fiscal year 2019. The SM-3 Block IIA received a positive initial production decision in October 2019.[62]

January 2021 DOT&E Report

A January 2021 report from DOD's Director, Operational Test and Evaluation (DOT&E)—DOT&E's annual report for FY2020—stated the following in its section on the Aegis BMD program:

> **Assessment**
>
> • Aegis BMD continues to demonstrate a capability to intercept non-separating, simple-separating, and complex-separating ballistic missiles in the midcourse phase of flight with SM-3 missiles. Aegis BMD has also demonstrated a capability to intercept select ballistic missiles in the terminal phase of flight with SM-6 missiles. However, flight testing and M&S [modeling and simulation] have not addressed all expected threat types, ground ranges, and raid sizes. The MDA has used M&S to explore Aegis BMD raid engagement performance, but DOT&E has less confidence in these results because COMOPTEVFOR [the Navy Commander, Operational Test and Evaluation Force] has been unable to accredit the models due to the lack of validation data from live fire raid engagements and lack of post-intercept debris modeling.
>
> • During Pacific Dragon—2020 [a Navy fleet exercise in August 2020], the MDA demonstrated Aegis BMD interoperability with Republic of Korea naval assets while conducting simulated ballistic missile engagements. The AAMDTC [Aegis Ashore Missile Defense Test Complex] demonstrated Aegis interoperability with Australian naval assets while tracking ballistic missile targets.
>
> • DOT&E will provide an assessment of the FTM-44 [flight] test results and of the SBT [sea-based terminal] Increment 2 capability (based on the results of FTM-31 E1 and FTM-33) [flight tests] in separate reports.
>
> • MDA ground tests have routinely shown that inter-element coordination and interoperability need improvement to improve engagement efficiency; however, flight testing with multi-element engagement coordination has been limited. Aegis BMD has exercised rudimentary engagement coordination with Terminal High-Altitude Area Defense [THAAD] [BMD] firing units, but not with [the] Patriot [BMD system]. The MDA plans to exercise engagement coordination between those three theater elements during Flight Test Operational (FTO)-05, but that flight test has been repeatedly delayed and is currently planned for FY28.
>
> • DOT&E and USD(R&E) [Under Secretary of Defense for Research and Engineering] have prompted the MDA to establish a ground testing approach to support assessments of missile reliability. DOT&E cannot assess SM-3 missile reliability with confidence until the MDA is able to provide additional ground test data that simulate the in-flight environment.
>
> • The MDA delivered results from a subset of the high-fidelity M&S operational test runs for record for the SM-3 IIA missile. The MDA found a problem in one of the models used to conduct the M&S runs. The MDA has identified a fix action and the test runs will be re-run and delivered in FY21. The data from these re-executed runs will support the DOT&E assessment of the operational effectiveness of the SM-3 Block IIA missile in FY21.
>
> • COVID-19 impacts have delayed delivery of high-fidelity M&S operational test runs for record to support an assessment of SBT Increment 2 operational effectiveness. Verification

[62] Government Accountability Office, *Missile Defense[:] Assessment of Testing Approach Needed as Delays and Changes Persist*, GAO-20-432, July 2020, pp. 44, 45-46, 48-49, 51-52.

and validation data from flight testing will not be available until FY21 to support model accreditation. M&S operational test runs for record will not be available until FY22.

• The developmental AN/SPY-6(V)1 radar continues to track ballistic missiles during MDA flight tests. The radar detected and tracked the HGV [hypersonic glide vehicle] target in FEX-01.

Recommendations

The MDA should:

1. Prioritize resources for FTO-05 to ensure this critical flight test occurs as soon as possible.

2. Conduct Aegis BMD midcourse and terminal phase flight testing with live fire intercepts of raids of two or more ballistic missile targets to aid in the validation of M&S tools.

3. Improve Aegis BMD high-fidelity M&S tools to incorporate post-intercept debris modeling to better assess engagement performance in raid scenarios.

4. Provide data from high-fidelity ground tests to DOT&E to inform SM-3 Block IB Threat Upgrade and Block IIA missile reliability estimates.

5. Work with DOT&E and USD(R&E) to establish a ground testing approach to support assessments of missile reliability.[63]

Regarding the SM-6 missile, the January 2021 DOT&E report also stated the following:

Assessment

• As reported in the FY18 DOT&E SM-6 BLK I FOT&E [Follow-on Operational Test and Evaluation] Report, the SM-6 remains effective and suitable with the exception of the classified deficiency identified in the FY13 IOT&E [Initial Operational Test and Evaluation] Report and two additional problems discovered during FY17 SM-6 BLK [block] I testing to verify corrected deficiencies. The SM-6 BLK IA FOT&E analysis is consistent with prior reporting.

• While post-flight test data appears promising, DOT&E will assess the results of the developmental/engineering flight test to examine corrective actions to a classified performance deficiency discovered during FY17 SM-6 BLK verification of correction of deficiency tests. This assessment will occur in FY21.

Recommendations

The Navy should:

1. Fully assess the corrective actions implemented to address the additional problems encountered during FY17 SM-6 BLK I verification of corrected deficiency tests by conducting a verification of deficiency operational flight test.

2. Plan and conduct lethality assessments for the SM-6 FCD [Future Capabilities Demonstration] capabilities.[64]

Legislative Activity for FY2022

Summary of Action on FY2022 MDA Funding Request

Table 2 summarizes congressional action on the FY2022 request for MDA procurement and research and development funding for the Aegis BMD program.

[63] Department of Defense, Director, Operational Test & Evaluation, *FY2020 Annual Report*, January 2021, p. 218.

[64] Department of Defense, Director, Operational Test & Evaluation, *FY2020 Annual Report*, January 2021, p. 168.

Table 2. Summary of Congressional Action on FY2022 MDA Funding Request

(In millions of dollars, rounded to nearest tenth; totals may not add due to rounding)

		Authorization			Appropriation		
	Request	HASC	SASC	Conf.	HAC	SAC	Conf.
Procurement							
Aegis BMD (line 31)	334.6	334.6			334.6		
(SM-3 Block IB missile quantity)	*(40)*	*(40)*			*(34)*		
Aegis BMD Advance Procurement (line 32)	17.5	17.5			17.5		
SM-3 Block IIA (line 34)	295.3	336.8			295.3		
(SM-3 Block IIA missile quantity)	*(8)*	*(10)*			*(6)*		
Aegis Ashore Phase III (line 38)	25.9	25.9			25.9		
Aegis BMD hardware and software (line 40)	81.8	81.8			81.8		
Subtotal Procurement	**755.1**	**796.6**			**755.1**		
Research, development, test, and evaluation (RDT&E)							
Aegis BMD (PE 0603892C) (line 86)	732.5	780.9			633.5		
Aegis BMD test (PE 0604878C) (line 118)	117.1	117.1			111.3		
Land-based SM-3 (PE 0604880C) (line 120)	43.2	43.2			43.2		
Subtotal RDT&E	**892.8**	**941.2**			**788.0**		
TOTAL	**1,647.9**	**1,737.8**			**1,543.1**		

Source: Table prepared by CRS based on DOD's original FY2022 budget submission, committee and conference reports, and explanatory statements on FY2022 National Defense Authorization Act and FY2022 DOD Appropriations Act.

Notes: HASC is House Armed Services Committee; **SASC** is Senate Armed Services Committee; **HAC** is House Appropriations Committee; **SAC** is Senate Appropriations Committee; **Conf.** is conference agreement.

FY2022 National Defense Authorization Act (H.R. 4350)

House

The House Armed Services Committee, in its report (H.Rept. 117-118 of September 10, 2021) on H.R. 4350, recommended the funding levels shown in the HASC column of **Table 2**. The recommended increase of $41.5 million for line 34 is for "Procure 2 additional all-up rounds." (Pages 396-397) The recommended increase of $48.4 million for line 86 is for "Navy SPY Radar Digital Upgrade." (Page 443)

H.Rept. 117-118 states:

> *Aegis radar*
>
> The committee recognizes that the rapid deployment of next-generation maritime radar systems is required to address existing and emerging gaps in integrated air and missile defenses, particularly in the Indo-Pacific region. However, the committee is concerned by the apparent lack of alignment and congruent planning between three concurrent Aegis Baseline radars funded at various stages of development or production across the Navy and Missile Defense Agency. Specifically, the Navy budget includes funding for the backfit of AN/SPY–6(V), which began low-rate production in 2016 and will enter full-rate production upon the award of a hardware production and sustainment contract anticipated

> by the end of fiscal year 2021. The Navy budget also includes funding for the development of a digital low noise amplifier modification to the existing AN/SPY–1 radar. At the same time, the Missile Defense Agency budget includes funding for the development of a variant of the Long Range Discrimination Radar for use in Aegis Ashore applications.
>
> The committee believes there are opportunities to better leverage common, mature radar technology in modernizing all Aegis-based platforms, including through U.S. Navy weapon systems applications aboard existing surface ships, Homeland Defense Guam, and/or defense of the continental United States from cruise missiles or air and missile defense threats. Leveraging such commonality across platforms would serve as a means to achieve critical distributed maritime operations objectives by expanding the number of deployed netted sensors while also proliferating the number of sensors capable of simultaneously defending against advanced air and missile defense threats. Moreover, the committee believes that better aligning Aegis Baseline radar investments would also serve to reduce risk and lower acquisition, lifecycle, and sustainment costs.
>
> Therefore, the committee directs the Director of Cost Assessment and Program Evaluation to conduct a review of the three Aegis Baseline radars included in the budget request for fiscal year 2022 and to submit a report to the congressional defense committees not later than December 1, 2021, outlining the results of this review and making recommendations for achieving greater affordability, commonality, and sustainability through improved alignment of radar modernization investments. (Page 16)

H.Rept. 117-118 also states:

> Layered Defense for the Homeland
>
> The committee notes advances in long-range missile capabilities by rogue states, particularly by making significant developments towards more sophisticated missile and rocket technologies, from use of solid fuels to developing new submarine-launched ballistic missiles. The committee continues to encourage the Department of Defense to analyze and assess these variable threats posed by these missile and rocket capabilities, as well as provide an analysis of gaps in homeland missile defense, with focus on missile defense gaps along the east coast of the United States. As such, the committee looks forward to receiving from the Department a report on layered homeland missile defense system as directed by section 1648 of H.R. 6395, the William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021, as passed by the House.
>
> Further, the committee notes the successful test of the Aegis Weapon System (AWS) and Standard Missile-3 (SM-3) Block IIA against an intercontinental-range ballistic missile (ICBM) in November 2020, and funding requested by the Missile Defense Agency to continue development of a layered defense architecture. Therefore, the committee directs the Director of the Missile Defense Agency, in coordination with the Under Secretary of Defense for Policy, Chief of Naval Operations, and Commander of U.S. Northern Command, to submit a report to the House Committee on Armed Services by December 31, 2021, on development and deployment plans for using the AWS with SM–3 Block IIA interceptors as part of a layered missile defense system. The report shall include:
>
> (1) requirements for deploying a layered defense using the AWS and SM–3 Block IIA for defense of the continental United States (CONUS);
>
> (2) analysis of future AWS and SM–3 Block IIA locations that would support improved defensive coverage of CONUS, and how the preferred location of Fort Drum, NY, for a CONUS interceptor site using Ground-Based Interceptors could be leveraged for a future layered defense system;
>
> (3) analysis of how deploying Arleigh Burke-class guided-missile destroyers for the homeland missile defense mission would impact Navy readiness and global force management;

(4) should land-based AWS systems be deployed for layered homeland defense, the applicable manning strategy; and

(5) any applicable lessons learned from analysis conducted for the Guam Defense System that could be applied to a layered homeland defense architecture, particularly for locations previously evaluated and preferred for a CONUS interceptor site. (Page 281)

FY2022 DOD Appropriations Act (H.R. 4432)

House

The House Appropriations Committee, in its report (H.Rept. 117-88 of July 15, 2021) on H.R. 4432, recommended the funding levels shown in the HAC column of **Table 2**.

Although the recommended funding levels for lines 31 and 34 are the same as the requested figures, the quantities of missiles to be procured under those two funding lines have been reduced by six missiles and two missiles, respectively, as shown in the table. (Page 228)

The recommended reduction of $98.963 million for line 86 is for "Unjustified growth—AEGIS LHD lack of validated requirement and acquisition strategy." (Page 314) The recommended reduction of $5.8 million for line 118 is for "Unjustified growth—AEGIS LHD test funding early to need." (Page 315)

Appendix. Reported Aegis BMD Flight Tests

Table A-1 presents a summary of reported Aegis BMD flight tests since January 2002. In addition to the flight tests shown in the table, on February 20, 2008, a BMD-capable Aegis cruiser operating northwest of Hawaii used a modified version of the Aegis BMD system with the SM-3 missile to shoot down an inoperable U.S. surveillance satellite that was in a deteriorating orbit.

Table A-1. Reported Aegis BMD Flight Tests From January 2002 to the Present

Date	Country	Name of flight test of exercise	Ballistic Missile Target	Successful?	Cumulative successes	Cumulative attempts
Exo-atmospheric (using SM-3 missile)						
1/25/02	US	FM-2	Unitary short-range (TTV)	Yes	1	1
6/13/02	US	FM-3	Unitary short-range (TTV)	Yes	2	2
11/21/02	US	FM-4	Unitary short-range (TTV)	Yes	3	3
6/18/03	US	FM-5	Unitary short-range (TTV)	**No**	3	4
12/11/03	US	FM-6	Unitary short-range (TTV)	Yes	4	5
2/24/05	US	FTM 04-1 (FM-7)	Unitary short-range (TTV)	Yes	5	6
11/17/05	US	FTM 04-2 (FM-8)	Separating short-range (MRT)	Yes	6	7
6/22/06	US	FTM 10	Separating short-range (TTV)	Yes	7	8
12/7/06	US	FTM 11	Unitary short-range (TTV)	**No**	7	9
4/26/07	US	FTM 11 Event 4	Unitary short-range (ARAV-A)	Yes	8	10
6/22/07	US	FTM 12	Separating short-range (MRT)	Yes	9	11
8/31/07	US	FTM-11a	Classified	Yes	10	12
11/6/07	US	FTM 13	Unitary short-range (ARAV-A)	Yes	11	13
			Unitary short-range (ARAV-A)	Yes	12	14
12/17/07	Japan	JFTM-1	Separating short-range (MRT)	Yes	13	15
11/1/08	US	Pacific Blitz	Unitary short-range (ARAV-A)	Yes	14	16
			Unitary short-range (ARAV-A)	**No**	14	17
11/19/08	Japan	JFTM-2	Separating short-range (MRT)	**No**	14	18
7/30/09	US	FTM-17	Unitary short-range (ARAV-A)	Yes	15	19
10/27/09	Japan	JFTM-3	Separating short-range (MRT)	Yes	16	20
10/28/10	Japan	JFTM-4	Separating short-range (MRT)	Yes	17	21
4/14/11	US	FTM-15	Separating intermediate range (LV-2)	Yes	18	22
9/1/11	US	FTM-16 E2	Separating short-range (ARAV-B)	**No**	18	23
5/9/12	US	FTM-16 E2a	Unitary short-range (ARAV-A)	Yes	19	24
6/26/12	US	FTM-18	Separating short-range (MRT)	Yes	20	25
10/25/12	US	FTI-01	Separating short-range (ARAV-B)	**No**	20	26
2/12/13	US	FTM-20	Separating medium-range (MRBM-T3)	Yes	21	27

Date	Country	Name of flight test of exercise	Ballistic Missile Target	Successful?	Cumulative successes	Cumulative attempts
5/15/13	US	FTM-19	Separating short-range (ARAV-C)	Yes	22	28
9/10/13	US	FTO-01	Separating medium-range (eMRBM-T1)	Yes	23	29
9/18/13	US	FTM-21	Separating short-range (ARAV-C++)	Yes	24	30
10/3/13	US	FTM-22	Separating medium-range (ARAV-TTO-E)	Yes	25	31
11/6/14	US	FTM-25	Separating short-range (ARAV-B)	Yes	26	32
6/25/15	US	FTO-02 E1	Separating medium-range (IRBM T1)	n/a[a]	26	32
10/4/15	US	FTO-02 E2	Separating medium-range (eMRBM)	n/a[b]	26	32
10/20/15	US	ASD-15 E2	Separating short-range (Terrier Orion)	Yes	27	33
11/1/15	US	FTO-02 E2a	Separating medium-range (eMRBM)	**No**	27	34
12/10/15	US (Aegis Ashore)	FTO02 E1a	Separating medium-range (IRBM T1)	Yes	28	35
2/3/17	US-Japan	SFTM-01	Separating medium-range (MRT)	Yes	29	36
6/21/17	US-Japan	SFTM-02	Medium-range	**No**	29	37
10/15/17	US	FS17	Medium-range target	Yes	30	38
1/31/18	US (Aegis Ashore)	FTM-29	Intermediate-range target	**No**	30	39
9/11/18	Japan	JFTM-05	Simple separating target	Yes	31	40
10/26/18	US	FTM-45	Medium range	Yes	32	41
12/10/18	US (Aegis Ashore)	FTI-03	Intermediate-range target	Yes	33	42
11/16/20	US	FTM-44	ICBM target	Yes	34	43
5/26/21 and 30/2021	US-Netherlands	ASD/FS21[c]	Non-separating MRBM target	Yes[c]	35[c]	44[c]
Endo-atmospheric (using SM-2 missile Block IV missile and [for MMW E1 and subsequent] SM-6 Dual I missile)						
5/24/06	US	Pacific Phoenix	Unitary short-range target (Lance)	Yes	1	1
6/5/08	US	FTM-14	Unitary short-range target (FMA)	Yes	2	2
3/26/09	US	Stellar Daggers	Unitary short-range target (Lance)	Yes	3	3
7/28/15	US	MMW E1	Unitary short-range target (Lance)	Yes	4	4
7/29/15	US	MMW E2	Unitary short-range target (Lance)	Yes	5	5
12/14/16	US	FTM-27	Unitary short-range target (Lance)	Yes	6	6

Date	Country	Name of flight test of exercise	Ballistic Missile Target	Successful?	Cumulative successes	Cumulative attempts
8/29/17	US	FTM-27 E2	Medium-range target (MRBM)	Yes	7	7
5/29/21	US	FTM-31	Medium-range target (MRBM)	**No**	7	8
7/24/21	US	FTM-33	Two SRBM targets	Yes and **unconfirmed**[d]	8 and unconfirmed[d]	9 and 10

Sources: Table presented in MDA fact sheet, "Aegis Ballistic Missile Defense Testing," February 2017, accessed on August 27, 2020, at https://web.archive.org/web/20170929180757/https:/www.mda.mil/global/documents/pdf/aegis_tests.pdf, and (for flight tests subsequent to February 2017) MDA news releases.

Notes: TTV is target test vehicle; **ARAV** is Aegis Readiness Assessment Vehicle. In addition to the flight tests shown above, there was a successful use of an SM-3 on February 20, 2008, to intercept an inoperative U.S. satellite—an operation called Burnt Frost.

a. MDA's table shows this as a test that did not result in the launch of an SM-3. MDA as of August 3, 2015, had not issued a news release discussing this event. MDA's count of 31 successful intercepts in 37 launches through July 29, 2015, does not appear to include this test, suggesting that this was considered a "no test" event—a test in which there was a failure that was not related to the Aegis BMD system or the SM-3 interceptor. News reports state that the test was aborted due to a failure of the target missile. (Andrea Shalal, "U.S. Skips Aegis Ashore Missile Test After Target Malfunction," *Reuters*, June 26, 2015.) MDA's table similarly shows the test of December 7, 2006, as a test that did not result in the launch of an SM-3. MDA issued a news release on this test, which stated that an SM-3 was not launched "due to an incorrect system setting aboard the Aegis-class cruiser USS *Lake Erie* prior to the launch of two interceptor missiles from the ship. The incorrect configuration prevented the fire control system aboard the ship from launching the first of the two [SM-3] interceptor missiles. Since a primary test objective was a near-simultaneous launch of two missiles against two different targets, the second interceptor missile was intentionally not launched." MDA counts the test of December 7, 2006, as an unsuccessful intercept in its count of 31 successful intercepts in 37 launches through July 29, 2015.

b. MDA's table shows this as a test that did not result in the launch of an SM-3. MDA as of November 10, 2015, had not issued a news release discussing this event. MDA's count of 32 successful intercepts in 39 launches through November 1, 2015, does not appear to include this test, suggesting that this was considered a "no test" event—a test in which there was a failure that was not related to the Aegis BMD system or the SM-3 interceptor.

c. ASD/FS21 was an at-sea demonstration that occurred during a multilateral naval exercise called Formidable Shield 2021. In the demonstration, a Dutch frigate used its radar to provide early warning track data to a U.S. Navy destroyer that used the data to calculate a firing solution and launch its interceptor. Some press reports state that ASD/FS21 involved two successful ballistic missile intercepts, rather than the one shown in the table.

d. MDA stated that "based on initial observations, one target was successfully intercepted. At this time, we cannot confirm the second target was destroyed." ("MDA Test Intercepts Target," MDA News Release 21-NEWS-0012, July 24, 2021.)

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Specialist in Naval Affairs

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